# STUDIES IN THE COST OF URBAN TRANSPORTATION SERVICE

By
F. W. DOOLITTLE
Director

Bureau of Fare Research

American Electric Railway Association



Published by the
AMERICAN ELECTRIC RAILWAY ASSOCIATION
From the Office of the Secretary
8 West 40th Street, New York, N. Y.
1916

## PREFACE

*To the Executive Committee of the American Electric Railway Association:*

Two years ago the Committee on Cost of Passenger Transportation Service of the American Electric Railway Association recommended the formation of the Bureau of Fare Research. The Committee referred to some of the problems, the study of which was then to be assigned to the Bureau. Mr. F. W. Doolittle was selected to fill the position of Director and began his work in May, 1914. Since that date the work of the Bureau has been conducted under the general supervision of this Committee. It has covered generally the ground as originally planned. The Bureau has made a number of special investigations, the results of some of which have been published from time to time. Publication of the results of other studies has been withheld until sufficient material has been gathered to make a fairly comprehensive summary of the many factors affecting the cost of passenger transportation service.

All the investigations bearing on the cost of service so far made by the Bureau, have been assembled under the title, "Studies in the Cost of Urban Transportation Service," and are offered to the Association and others interested in the economic factors affecting street railway rates of fare and service in the hope that they will assist in clearing up much of the misunderstanding that prevails in many quarters as to the actual financial results of electric railway operation and the possibilities of lower fares and larger contributions from electric railways toward the cost of government.

The electric railway industry is indebted to Mr. Doolittle for this comprehensive summary of cost and service factors. The Committee would be highly unappreciative if it did not record its thanks to Mr. Edwin Gruhl, who carried the burden of representing the Committee in many of the conferences with Mr. Doolittle.

Respectfully submitted,

Charles N. Black,
Henry G. Bradlee,
Thomas N. McCarter,
Paul Shoup,
James D. Mortimer, *Chairman*,

*Committee on Cost of Passenger Transportation Service.*

October 1, 1915.

## TABLE OF CONTENTS

## LIST OF FIGURES.

# PART I.

## THE OCCASION FOR COST OF SERVICE

# STUDIES IN THE COST OF URBAN TRANSPORTATION SERVICE

## CHAPTER I

### CREATING THE STREET RAILWAY

Introduction,—— Obtaining of Franchises,—— Promotion Expenses,—— Financing the Enterprise,—— Effect of Layout on Cost,—— Cost of Change of Motive Power,—— Expenses Incurred in Consolidation,—— Receivership,—— Unproductive Capital Expenditures,—— Influence of Capital Investment on Cost.

The operation of any productive enterprise occasions costs. These costs consist of contributions of materials, efforts and sacrifices, and such returns as will induce capital funds to be diverted from investment in other competing enterprises. Where such costs are accounted for they are measured in terms of money. Unless the value or price of a product equals or exceeds cost, the enterprise will sooner or later cease. Small enterprises with little fixed capital will stop producing as soon as costs exceed returns. Large enterprises with considerable capital invested may continue for some period even though costs exceed returns, in the hope that the returns sacrificed will be later reimbursed. The continuance of any productive effort is determined by the margin between productive cost and selling price. Street railways are not exceptions to this elementary principle of economics.

In businesses other than the traction industry, the failure to meet costs may be due to a variety of causes. The enterprise may have been misdirected and there may have been no demand for its product. The production costs may have been more than the product was worth. The value of the product may have exceeded the selling price, but selling prices were fixed below cost, due to the ignorance of the producer. The cost may have been excessive as compared with the cost of an available substitute.

However, the failure to meet costs in the traction industry is not due to any of the above named causes. There is everywhere a demand for street railway service and whenever this demand is not continuous and growing, the fault lies with the community and not with the street railway company. Moreover, while urban transportation service is one of the principal bases of community life and wealth, its selling price is considerably less than its value. This failure to charge cost prices is not due to ignorance on the part of those in control of the industry, but to the operation of artificial legal restraints which do not obtain in other industries. Finally, the costs of production or service are the economical costs and in all cases far less than those of any available substitute. In brief, in the street railway business the failure to meet production costs is due principally to causes beyond the control of the management, prominent among which is the inadequacy of the rate of fare fixed for the service rendered.

The cost of service of electric railways arises from many sources not readily appreciated by the street railway patron. Aside from the investment in physical property such as car stations, tracks and rolling stock, with which the passenger comes in contact, there have been many capital expenditures necessary to create and develop the modern street railway system. Similarly, operating expenses are associated chiefly with the cost of electric current and wages of conductors and motormen. Such a conception ignores large factors of cost arising out of the complicated organization which is an integral but not an obvious part of the furnishing of transportation. This organization though unseen is as necessary as the most familiar processes in the operation of cars.

In this chapter the costs occasioned in creating the street railway will be briefly touched upon. In the following chapter the costs of developing and operating the street railway organization as a going concern will be described. The nature, tendency and measurement of costs, and the characteristics and measurement of service rendered may then be more carefully examined in the succeeding parts of the book. Finally the general facts and principles outlined may be applied to the concrete and specific problems of costs involved in the extension of area served, in the extension of transfer privileges, in the compliance with service standards and in the studies of rapid transit.

The street railway had its beginning when some individual or individuals conceived the idea that the probable increase in population and accompanying growth of industrial activity would be such as to warrant the undertaking. In a large number of the urban communities whose populations now extend into hundreds of thousands, this beginning occurred somewhat prior to 1860.

It was necessary first of all to secure a permit or franchise to operate on the city streets. The earlier franchises were usually brief, general in terms, prescribed no definite routes, and frequently were not for long periods. In many of the Eastern States such franchises were granted by special legislative acts, but in time general statutory provisions were enacted more closely defining the terms and conditions of grants. As a rule the community was well satisfied to grant the necessary consents and took pride in the pioneering venture. In fact, during the earlier period, the number of franchises granted was considered a measure of progress and this idea was responsible for much expensive duplication of facilities for furnishing transportation service.[1] In spite of this favorable attitude on the part of the com-

[1] The franchises under which these early public utilities were promoted, constructed and operated, were generally granted on easy terms and contained many loose provisions, the chief interest of communities at that time being to make certain that the investment would be undertaken and the service furnished; and if any value was attached to the franchise, it was its value to the community in making certain that the particular service would be assured its inhabitants. Because of this viewpoint, competition and duplication were encouraged in every possible manner and franchises were indiscriminately granted all applicants.— Municipal Coöperation in Public Utility Management: by Philip J. Kealy — *Proceedings of the American Institute of Electrical Engineers*, October, 1915.

munity, there arose in connection with the obtaining of franchises, early and frequent occasion for expenditure, on the part of the applicants, of large amounts for legal services, advertising, consents of property owners, and other expenses of a similar nature.

The Middle Western and Western States, following the usual practice of patterning laws after those already in effect in older and more densely populated communities, met new enterprises with complete and detailed schedules of requirements, some not being particularly in point as, for example, paving requirements in cities whose streets were still unpaved. In later years, the consolidation of lines and the renewal of franchises were accompanied by further obligations for taxes, paving, sprinkling and cleaning streets, and definite provisions as to type of construction to be employed and the frequency and character of the service to be rendered.

While individuals have in many cases accepted franchise obligations, the history of the street railway industry shows that rarely has such a project been carried to the operating stage by an individual alone. The projector usually being unable to command sufficient capital was forced to associate others with himself in the formation of a corporation to promote the enterprise. Incorporation carried with it the expense of legal opinion as to many matters. First, it was necessary to determine the domicile or state in which the street railway was to be incorporated and following this many other questions arose which necessitated the obtaining of legal opinion. These opinions entailed fees and in addition other fees were required by the state upon the issuance of the charter.

The financing of the enterprise presented further difficulties. Communities were growing and their development not infrequently absorbed all the available home capital. It therefore often became necessary to seek capital in other localities. The difficulty of financing a new and untried enterprise requires no extended comment. It was necessary that the appeal for financial aid be made in such a manner as to create a favorable impression upon those with capital to invest. This required the preparation and distribution of a prospectus containing a brief history of the community to be served, the prospect of continued growth, diagrams of proposed routes, estimates of cost of construction, estimates of revenues to be derived from operation, and the resulting return upon the investment. An examination of some of the early prospectuses leads to the conclusion particularly in the light of subsequent occurrences, that promoters' views of the new enterprise were unusually optimistic, or that it was necessary to picture the opportunity to investors in an unusually alluring manner. As an inducement to prospective investors, it was necessary to offer the initial issue of stock far below par value, accompanied perhaps by the guaranty of a financial institution as to the payment of dividends beginning after a certain period of operation. To insure the avail-

ability of necessary capital when required, and in view of the uncertainty of such capital being obtained from those invited to invest, it was customary to form an underwriting syndicate, composed of bankers or other capitalists who agreed to purchase those securities not taken by the persons to whom they were originally offered. This obligation was undertaken only upon the agreement of the issuing corporation to pay a fixed commission, or upon an agreement to sell such unsubscribed securities to the underwriters at a substantial fixed discount. It is therefore obvious that the costs of promotion of the enterprise could, and frequently did, run into large figures.

Few street railways have been financed entirely by the sale of stock, although many of the earlier promoters attempted to keep the enterprise free from debt. Frequently the proceeds of the sale of the initial issue of stock remaining after defraying franchise, engineering, promotion, legal and other expenses, were relatively small and permitted the construction of but a small part of the projected work. The problem of additional financing to carry the project to the operating stage was then encountered. The necessity of added investment was not assuring to the original stockholders, but it was apparent that unless the project was pushed to completion, the money already invested would be lost. These considerations often paved the way for the sale of short-term notes, usually bearing a high rate of interest, and with such funds construction was continued and the equipment immediately needed was purchased.

Financing under such conditions was costly. Once in operation, the promising character of extensions, the early date of maturity of the short-term notes, and the necessity of lower interest costs, brought forcibly before the corporation the advisability of financing through obligations maturing serially or at a time sufficiently far in the future to permit the development of the enterprise before such obligations would have to be met. This could be accomplished only by providing the necessary security and there thus came into existence the mortgage bond. The preparation of the mortgage was not without its difficulties. The statutes of some states provided that the mortgage debt should not exceed the capital stock and since early capital stock issues were small, while the demand for additional capital was great, there arose the necessity for increases in the amount of stock issued.

While the provisions of earlier mortgages were broad and covered a wide variety of expenditures for physical property, including in some instances, horses, mules and harness, the sale of bonds was effected only at substantial discount and perhaps with the added inducement of a stock bonus. As a result only a part of the total amount, which had to be repaid, was ever received. It is true, that as compared with the cost of money on unsecured loans, nominal interest rates were relatively low. However, the items of legal fees, trustee's fees, brokerage and discount invariably amounted to a considerable

sum and served to make the nominal interest rate a poor index of the actual cost of capital.

The earlier street railway mortgages were limited in many cases to a life of twenty years, because this seemed ample provision for the future and because in many cases the term of franchises did not exceed this period. The total amounts of bonds issuable under the mortgages ranged from five hundred thousand to five million dollars. The unexpected rapid development of the industry, however, requiring extensions not anticipated at the time the original mortgage was drawn, eventually disclosed the inadequacy of such financing and thereupon the company was confronted with the problem of the closed mortgage. Issues of new bonds could be secured only by secondary liens and to market these junior securities, as they were called, higher rates of interest had to be offered. Where earlier mortgages contained no provision for the redemption of securities prior to their maturity, it was necessary to place a consolidated or refunding mortgage upon the entire property, and where provisions for redemption prior to maturity had been made, it was necessary to refund the original issue at a premium usually ranging from five to ten per cent of the face amount of the debt. It should be pointed out in this connection that the actual effect of the sale of bonds at a discount has perhaps never been sufficiently appreciated. Not only did the issuing corporation receive an amount of money considerably less than the amount which it obligated itself to pay upon a certain date, but in addition it agreed to pay interest on such excess obligation until the date of maturity. It will thus be seen that the burden imposed was a double one and contributed largely to the cost of creating a street railway.

During the years that have elapsed since the idea of furnishing street railway transportation first developed, the promoters or their successors have had to maintain offices with the salaries and expenses incident to such maintenance. These continuous expenses, often totally unknown and invisible to the average person, are in addition to the expenses of securing franchises, incorporation, promotion and financing the enterprise. They represent the prelimiary outlay and it is a common practice to calculate the amount required for such preliminary outlay as a percentage of the estimated cost of the physical plant. This method, of course, affords large opportunity for inaccuracy. It is obvious that such expenses may amount to considerable sums before construction is begun and will vary widely with different traction companies.

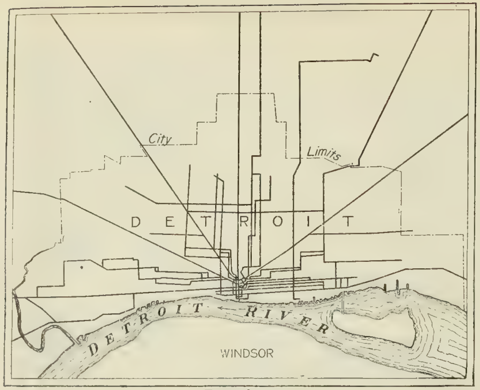
The geographical and economic characteristics of a city have always had an important influence upon the planning of a city's traction system, the relative location of business and residence districts determining the lines of most frequent travel and thus the layout of the system. The cities of half a century ago were relatively small in area and their horse car systems comprised few routes and were

simple as compared with modern electric railway layouts. However, with urban growth and development, there were devised in some cities systems with converging or radial lines, and systems of the gridiron type in others.[1] Each type of system presented and still presents its own peculiar operating difficulties. Whenever the lines of travel change, it may become necessary to abandon routes which previously were profitable and this entails upon the company a considerable loss both in revenue and abandoned physical capital. The different types of cities and the traction layouts adapted thereto are shown in Fig. 1. This chart brings out very clearly the effect of geographical and economic conditions upon the location of lines.

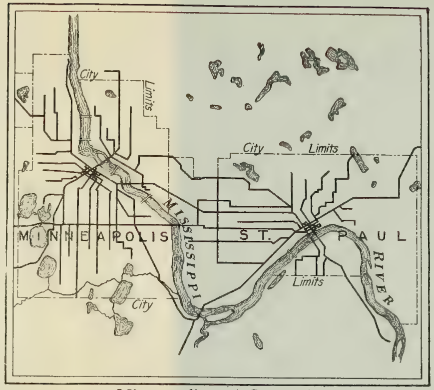
Traction layouts, aside from their operating significance, determine the proportionate parts of tangible capital investment devoted to track, structures, rolling stock, power plant, car stations and other equipment, as is indicated in Table I. Where the city is compact and the flow of traffic is general and uniform, a considerably smaller investment is required per dollar of gross revenue than in the cases of cities in which passengers must be carried long distances and where the traffic originates in one district and terminates with very little local traffic in another district. The length of transmission and distribution system is dependent upon the physical layout of the tracks. The expenditures for power equipment and cars are primarily influenced by the extent of the peak hour service. It is not at all unusual for a company to have in service during a period of say thirty minutes of the day in which the requirements are at maximum, generating equipment four times as great as would be sufficient to handle the business if it were uniformly distributed. The peak load factor also determines the amount of investment in cars and in car storage facilities.

In addition to changes in traction layouts, the several changes in the past in motive power have also had their influence upon the street railway industry. The effect of such changes in motive power may be briefly commented upon. The capital construction of the earlier horse car companies comprised land, tracks, stables, horses or mules, and rolling stock. Usually stables and car stations were constructed as the same or adjacent buildings. The transition from horse car to cable and from cable to electric traction necessitated better centralization of equipment. It was desirable to have the power plant located centrally with respect to the car lines to be supplied in order to minimize energy losses. The change in motive power necessitated heavier track and rolling stock of different type. Where track had previously been laid upon stringers in the center of the street with little ballast, it became necessary to provide structures similar to those customary in steam railroad work. This radical change rendered

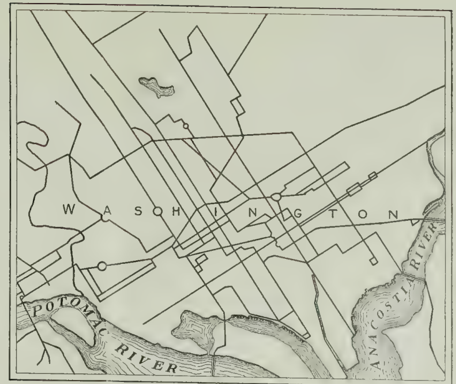
[1] For a comprehensive discussion of the factors affecting the city lay-out see Hurd, R. M., — *The Structure of Cities* 1910, Alexander Hamilton Institute, New York.



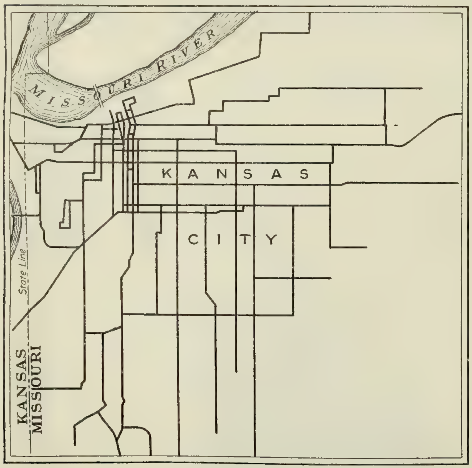
Detroit



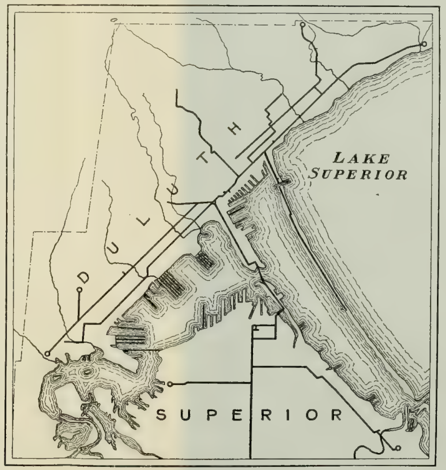
Minneapolis and St. Paul



Washington



Kansas City



Duluth and Superior

San Francisco

FIG. 1. TYPICAL TRACTION LAYOUTS.

TABLE I—DISTRIBUTION OF VALUATION OF PHYSICAL PROPERTY OF TRACTION SYSTEM IN PERCENTAGES OF TOTAL VALUE

| | Milwaukee Electric Railway and Light Company | | United Railways Co. of St. Louis | Cleveland Electric Railway | | Puget Sound Electric Railway Company | Detroit United Railways | Twenty-seven companies in Wisconsin | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | By arbitrator | | | | By Wisconsin Railroad Commission | | |
| | By city, 1910 | By company, 1897 | By commission, 1912 | 1908 | 1908 | Washington Public Service Commission, 1913 | By commission, 1914 | Average, 1913 | Maximum, 1913 | Minimum, 1913 |
| Track and electric distribution system | 50.7 | 42.5 | 49.8 | 36.5 | Note 35.6 | 46.0 | 43.2 | 48.4 | ...... | ...... |
| Roadway and track | ...... | ...... | .......... | ...... | ...... | 35.4 | ........ | 29.1 | 87.4 | 15.3 |
| Transmission and distribution | ...... | ...... | 49.8 | ...... | ...... | 10.6 | ........ | 19.3 | 24.1 | 4.5 |
| Paving | 6.3 | 12.9 | .......... | 11.8 | 11.4 | 1.8 | 4.0 | 4.6 | 22.3 | ...... |
| Buildings and equipment | 31.4 | 32.6 | 39.3 | 43.0 | 43.1 | 21.2 | 42.5 | 41.5 | ...... | ...... |
| Buildings and miscellaneous structures | ...... | ...... | .......... | ...... | ...... | .......... | ........ | 10.4 | 15.3 | ...... |
| Power plants and buildings | 15.5 | 20.2 | 19.5 | 24.1 | 22.7 | 7.0 | 15.7 | ...... | ...... | ...... |
| Power plants and substation buildings | ...... | 2.7 | 3.4 | | | 1.1 | | | | |
| Power plants and substation equipment | ...... | 8.4 | 11.7 | 18.1 | 17.2 | 3.6 | 9.0 | ...... | ...... | ...... |
| General and office buildings | ...... | ...... | .8 | ...... | ...... | 1.6 | ........ | ...... | ...... | ...... |
| Maintenance of way buildings | ...... | 9.1 | .4 | 6.0 | 5.5 | .......... | 6.7 | ...... | ...... | ...... |
| Car houses | ...... | ...... | 2.4 | ...... | ...... | .7 | ........ | ...... | ...... | ...... |
| Shops | ...... | ...... | .8 | ...... | ...... | .......... | ........ | ...... | ...... | ...... |
| Cars and car equipment | 15.9 | 12.4 | 19.8 | 18.9 | 20.4 | 14.2 | 26.8 | ...... | ...... | ...... |
| Plant equipment | ...... | ...... | .......... | ...... | ...... | .......... | ........ | 15.6 | 29.6 | ...... |
| General equipment | ...... | ...... | .......... | ...... | ...... | .......... | ........ | 15.5 | 30.5 | ...... |
| Land | 4.9 | 10.4 | 6.6 | 8.2 | 7.2 | 28.6 | 10.3 | 5.5 | 12.7 | ...... |
| Miscellaneous | 6.7 | 1.6 | 4.3 | .5 | 2.7 | 2.4 | ........ | ...... | ...... | ...... |
| TOTALS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | ...... | ...... |

Note—Including Forest City Railway

useless much of the investment previously made. In addition, the pioneer electric traction companies were required to operate as licensees of manufacturers and to pay large royalties for the right to use the newly patented generating and distributing equipment, car motors, etc. All this involved considerable expenditure often but poorly recorded. Moreover, both in the initial construction of the physical plant and in the later changes in it, many expenditures were incurred other than those for labor and material. Preliminary administrative and engineering expense, legal costs, and interest on money invested in construction prior to beginning of operation were some of the additional items not immediately represented in physical plant. These so-called overhead additions to construction costs have been recognized in subsequent appraisals but it is probable that the allowances made have been under estimated.[1] The desirability of complete and detailed construction records was not as apparent at that time at it has since become, and many companies had little but the outstanding securities to show for discarded property, the investment in which there was not opportunity to amortize.[2]

The change from horse cars to electric traction occurred about the time when the growth of the community demanded a rapid and interrelated rather than a segregated traction system. While many of the

---

[1] An interesting analysis of overhead charges is contained in the paper of H. G. Abendroth, published in AERA, November 1914. Mr. Abendroth states:

> * * * Every piece of construction work contains as overhead costs such items as planning the construction, designing proper equipment, making blue prints, preparing specifications, laying out the actual construction work, buying, housing, inspecting, labelling, charging and delivering the proper material, getting the men on the job and keeping them there, inspecting the work in process, testing out the finished construction and providing, in addition, the money for material and payroll advances, and the insurance to cover accidents, layoffs, floods, fire and theft.
>
> Every accountant and engineer knows that these costs exist, but, unfortunately, we are not always so certain as to how large they are. Like any measuring device, any cost accounting system has its shortcomings. Its ideal is to get collected together for record in one place all of the money efforts and time efforts expended upon one piece of work to give it value. * * * We doubt whether the best accounting department, using every effort, and designing forms to keep account of every form of cost, can apply the proper money values which represent all of the costs and efforts within eighty per cent of standard. This deficiency accounts for the difference between costs on the books and actual costs.

The paper contains original data upon the size of overhead costs as developed in Milwaukee. There is also given an interesting summary of overhead allowances in traction valuations. A Table from Mr. Abendroth's report is reproduced on the following page.

[2] See C. L. Allen, Railway History in One City, AERA, December 1915.

> The rate of fare charged up to this time (1898) had not been sufficient to pay interest on the investment nor did it provide any depreciation fund to which could be charged the value of the property which had been scrapped, amounting to millions of dollars. In those days, capital was willing to speculate. It took a chance that it would earn a greater return than if invested in real estate mortgages or other investments. Capital did not know that charges from revenue were necessary to provide a proper depreciation. In those days capital assumed that there would be no limitation on the rate of return it would be permitted to earn. In other words that capital would be permitted to earn the same rate of return as if it had been placed in a manufacturing enterprise.
>
> In a successful manufacturing business, the selling price of the manufacturing commodity is always high enough to provide for a depreciation fund for the retirement from the business of the plant and machinery, as well as such return upon capital as will make it attractive. In the electric railway business, transportation is sold. It is the commodity the corporation has to offer. The rates of fare charged for this commodity should be sufficient to provide a proper depreciation fund and reserves, as well as such a return on the capital as will make it attractive to the investor. This condition did not prevail between the years 1888 and 1896, nor does it prevail to-day.

### Overhead Charges on Traction Valuations

(From the analysis of H. G. Abendroth)

| | Total | Promotion and organization | Legal | Engineering | Superintendence | Interest during construction | Contractor's profit | Taxes and insurance | Contingencies | Brokerage and commissions |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Chicago Surface Railways, 1906, B. J. Arnold, M. E. Cooley, A. B. DuPont. | 21.7 | ........ | ...... | ...... | [1] 11.7 | ........ | ........ | ...... | [2] 10.0 | ....... |
| 2. Puget Sound Electric Railway, Washington Railroad Commission........ | 15.7 | ........ | 0.5 | 5.9 | 1.7 | 4.6 | ........ | ...... | 3.0 | ....... |
| 3. Appraisal of street railways for Massachusetts Validation Board, 1911..... | 29.0 | ........ | 4.0 | ...... | 5.0 | 10.0 | ........ | ...... | ........ | 10.0 |
| 4. Chicago Consolidated Traction Company, 1910, B. J. Arnold and George Weston........................ | 38.4 | ........ | ...... | ...... | [1] 14.6 | [3] 5.8 | ........ | ...... | ........ | 18.0 |
| 5. Metropolitan Street Railway System, Kansas City, Mo.................. | [4] 33.0 | 8.0 | 7.0 | ...... | ...... | 7.0 | ........ | ...... | ........ | ....... |
| 6. Coney Island and Brooklyn Road, Public Service Commission, First District, N. Y...................... | 24.81 | 5.15 | ...... | ...... | 5.15 | ........ | 9.36 | ...... | 5.15 | ....... |
| Ford, Bacon & Davis.............. | 34.0 | ........ | ...... | ...... | ...... | ........ | ........ | ...... | ........ | ....... |
| 7. Cleveland Street Railway, United States District, Judge Robert W. Taylor. | 22.18 | ........ | ...... | ...... | ...... | ........ | ........ | ...... | ........ | ....... |
| Ford, Bacon & Davis.............. | 17½–35.0 | ........ | ...... | ...... | [5] 5–10 | ........ | 7½–15.0 | ...... | 5–10.0 | ....... |
| William Bradley Parsons........... | [6] 30.0 | ........ | ...... | ...... | 5.0 | ........ | 10.0 | ...... | 5–10.0 | ....... |
| Stone and Webster................. | ........ | ........ | ...... | ...... | 10.0 | ........ | ........ | ...... | ........ | ....... |
| 8. Brooklyn Rapid Transit System....... | [7] 21.0 | ........ | ...... | ...... | ...... | ........ | ........ | ...... | ........ | ....... |
| 9. The Milwaukee Electric Railway & Light Company, Professor M. E. Cooley........................ | [8] 28.0 | 2.5 | ...... | ...... | 4.0 | 6.0 | ........ | 0.5 | 5.0 | ....... |
| 10. G. T. Bishop, President, Washington, Baltimore & Annapolis Electric Railway........................... | [9] 20.0 | ........ | ...... | ...... | ...... | ........ | ........ | ...... | ........ | ....... |
| 11. Reorganization Third Avenue Railway, N. Y., Henry Floy................. | 40.0 | ........ | ...... | ...... | ...... | ........ | ........ | ...... | ........ | ....... |

[1] Includes organization and incidentals. [2] Includes legal expense, interest and brokerage. [3] Includes legal expense and contingencies. [4] Eleven per cent average of additions to separate departments. [5] Includes organization. [6] Five per cent for miscellaneous. [7] Contractor's profit, incidentals, engineering and administration. [8] Acquiring 1 and 10 per cent. [9] Considered an under-estimate.

For further original data, see report of Committee on Overhead charges, *Proceedings American Electric Railway Accountants' Association*, 1913–1914.

competing horse car lines, for the existence of which there was no economic justification, had been absorbed in the then present systems, the length of ride for a single fare was limited and frequently two or more fares were charged for the transportation of a passenger to his destination. The advantages of centralized ownership and management with a common source of power supply, and the possibilities of transfer from line to line over a unified traction system, were the most important of the considerations which prompted the consolidation of the separate lines. The benefits of rapid transit on uniform schedule at a single fare with universal transfer have become so obvious that they no longer are the occasion of comment.

The consolidation or merger involved the purchase of the separate lines for cash or secuurities frequently in amounts in excess of the cost of obtaining franchises, expenses of promotion, and cost of physical property. The basis of acquisition was the value to the owners rather than costs, such value being calculated upon the supposed advantageous location of lines and probable future earnings. In many instances, the process of consolidation was hampered by the efforts of owners to capitalize a "nuisance value" which they had endeavored to create. Not only did the cost of the consolidated system include the duplication of investment in property, a large part of which was obsolete, and discounted future earnings, but the consolidated company also had to assume such contracts, leases or other obligations as the predecessor companies had undertaken. It is certain that if electric traction could have been developed when urban transportation systems were first needed, and public officials had recognized the advantages of a public policy of regulated monopoly rather than competition, substantial investments made in the actual process of growth of urban street railways would have been avoided.

The novelty of electric traction in its early life afforded a false stimulus to the industry and fostered erroneous ideas as to the future earning power of such systems. Because of this, frequently the obligations assumed in consolidation were burdens under which the systems could not profitably operate. High cost of consolidation or reorganization, over-extension, changes in business conditions, and depression were among the chief causes contributing to the weakened financial position in which many companies soon found themselves. Relief was sought from these conditions in receivership litigation, which involved considerable time and expense.

With the development of the community and the growth of the traction system, there have come many items of capital investment which are unproductive in their nature.[1] Comparisons of the relation

[1] The evidence before the board would seem to indicate that burdens have been thrown upon this company faster than the increase in traffic justifies. * * * If it be true that the metropolitan community is loading upon this company burdens which it cannot bear, the community is not only unwise in its own interest, but it is committing an act of rank injustice towards the 6,000 shareholders who have come forward to supply capital amounting to $25,586,828, including premiums. Second Annual Report of the Public Service Commission of Massachusetts, 1914, Vol. I, 440, 441.

of added dollars of invested capital per dollar of added gross earnings of several urban systems in recent years disclose the magnitude of these unproductive capital expenditures, many of which have been due to onerous municipal requirements. Among the latter are expenditures for paving, change of transmission and distribution systems from overhead to underground, protection against electrolysis, grade separations and expenditures for better car handling facilities.[1]

While the urban electric railway has normally a smaller percentage of investment in land than either the steam railroad or the interurban electric railway, its investment in this class of property is no inconsiderable item. It is well know that property owners capitalize the railways' necessity whenever possible and take advantage of the fact when their property is favorably located for railway use. Land for power houses, shops, car barns, and, with increasing frequency, for private rights of way, must be purchased and the ability of the original owners to fix their prices on the basis of the purchasers' necessity adds materially to the total investment required. An interesting example is that reported in 1914 to the Valuation Board of the Interstate Commerce Commission by the Northern Pacific Railway.[2] The transactions referred to occurred from 1905 to 1914 and indicate that the carrier found it necessary to pay several times as much for the various parcels of land as they were worth when measured by comparison with surrounding similar land.

The economic requirement of investment is certainty of return. If the return on investment is uncertain a higher rate of yield is required by the investor to offset the risk, or there must be assurance that the future will bring increased profits to compensate for early losses. The proportion of income to capital investment in the traction business is relatively small. Small changes in income therefore have a large effect upon capital return and return is a substantial element of the total cost of production.

---

[1] Power house design, affecting the electric railway, light and power companies, has undergone revolutionary changes from an engineering viewpoint. The replacing of the reciprocating engine by large turbo-generator units, the evolution in boiler and synchronous converter design and in the methods of transmission, all have undergone important changes and demanded an ever increasing investment. The constant extension of underground districts in the larger cities, within which all overhead wires must be removed to conduits, has entailed an enormous expenditure.

Perhaps the influence of the changes in the art upon the investment can be best summarized in the emphatic statement that, despite all of the tremendous engineering advancements which have been made regardless of the greater capacity of practically every unit now serving electric companies, whether it be in the power house, substation or street car, *the investment per dollar of gross earnings is today greater than it was twenty years ago.* And not only is the investment per dollar of gross earnings greater, but the rate for service remains the same or, more frequently, has been reduced, while the purchasing power of money has decreased so that investors are receiving less and less. Universal transfers have reduced the average fare about 30 per cent and a standard of service is now furnished which was formerly considered impossible to attain. Municipal Coöperation in Public Utility Management: by Philip J. Kealy, *Proceedings of the American Institute of Electrical Engineers*, October 1915.

[2] See Table page 14.

## COST OF ACQUISITION OF WAY AND GROUNDS

Condensed from Statement Prepared by Northern Pacific Railway Company, for the Valuation Board of the Interstate Commerce Commission

| LOCATION | Value of naked land | Value of improvements | Severance and other damages | Higher value for railway purposes and compulsory character of transactions | Total paid for land | Expense of acquisition | Total cost | Total cost in per cent of value of naked land |
|---|---|---|---|---|---|---|---|---|
| **Knife River Branch** | | | | | | | | |
| Dunn & Mercer Cos., N. Dak. | $27 775 | ........ | $16 791 | .......... | $44 566 | $9 259 | $53 825 | 194 |
| **St. Paul Coach Yard** | | | | | | | | |
| St. Paul, Minn. (A)* | $44 535 | $11 083 | ........ | $38 382 | $94 000 | $900 | $94 900 | 213 |
| St. Paul, Minn. (B)* | 49 536 | 69 132 | ........ | 151 032 | 269 700 | 2 653 | 272 353 | 550 |
| Total Coach Yard | $94 071 | $80 215 | ........ | $189 414 | $363 700 | $3 553 | $367 253 | 390 |
| **Bear Creek Branch** | | | | | | | | |
| Bridger to Belfry, Mont | $9 323 | | $73 323 | | $82 647 | $4 000 | $86 647 | 929 |
| Belfry to Bear Creek, Mont | 2 622 | | 11 239 | | 13 861 | 634 | 14 495 | 553 |
| Town lots | 2 206 | | 13 294 | | 15 500 | 750 | 16 250 | 736 |
| Total Bear Creek | $14 151 | | $97 857 | | $112 008 | $5 384 | $117 392 | 830 |
| Total three cases | $135 997 | | $384 277 | | $520 274 | $18 196 | $538 470 | 396 |

* A — Purchases before indentity of purchaser became known.
B — Purchases after identity of purchaser became known.

# CHAPTER II

## THE STREET RAILWAY AS A GOING CONCERN

What Creating and Operating the Going Concern Contributes to Cost,—— Organization of the Corporation,—— Organization of the Traction Utility,—— The Work of the Transportation Department, —— Power Plant Department,—— Electric Distribution Department,—— Rolling Stock Department,—— Way and Structures Department,—— Purchasing and Stores Department,—— Accounting Department,—— Legal Department,—— Employes Welfare,—— Work of Safeguarding the Public.

Two important aspects of the going concern contribute to the creation of costs of service — first, the large initial cost of building up the organization, and second, the continued cost of conducting the organization after it has been established.

At the expiration of the initial construction period of the plant, it is necessary to shape it into a going concern, or, in brief, to change it from a static to a dynamic condition. The electric railway property has always been of such size that the experience necessary to operate it could not be confined to a single individual. The selection of a proper organization at the outset therefore has been of much importance. The development of the industry has brought with it the necessity of further development of specialists in the various fields of operation, so that as the situation today exists in larger properties, the employes in one department are familiar only in a general way with the work of other departments. In many of the urban electric railway systems, the employes number in the thousands and one of the largest problems is the development of this organization and its maintenance at the point of maximum efficiency. The selection, training and the development of employes and the adoption of efficient methods of supervision have been costly.

In the manufacturing business these costs of building up the organization are frequently termed "Development Overhead," and usually increase the unit price of the manufactured article for a few years until the early costs are absorbed. The electric railway has had no similar method of providing for its costs of becoming a going concern. In all businesses the value of the going concern has been an important part of the value of the developed property.

We have discussed the formation of the corporation as one of the initial steps in creating the street railway. In organizing the corporation the stockholders elect directors and may directly, or the directors may in turn, elect the corporate officers, such as president, vice-president, secretary and treasurer, and assistant secretaries and assistant treasurers of the organization. The function of the corporate organization is to act as agent or trustee for the stock-

holders. The holdings of the greater number of stockholders of the usual street railway corporations are relatively small, the average falling much below one hundred shares. It is impossible for them to exercise the same care in watching the management of their property that would be exercised were a similar amount of money invested in a small mortgage or a small piece of real estate. The safeguarding of these interests in trust is the principal duty of the corporate organization. The corporate organization is in large part distinct from the street railway as a going concern. It must exist whether the investment has been placed in an operating property or whether the street railway still exists only on paper. The corporation may also under its charter engage in other business transactions besides those involved in operating a street railway. It may purchase property as an investment, it may invest in the stock and bonds of other corporations, and it may enter into contracts which are only remotely related to the transportation business.

As distinct from the corporate organization is the organization of the general management concerned with the direct operation of the traction utility. The responsibility of the general management is usually vested in the general officers of the corporation. In addition to the trust of safeguarding the property, the management has a responsibility, contractual in nature, to the public. The franchise of a street railway, giving it the exclusive right to do business in the city, carries with it the usual public obligations of a business of public calling or common carrier. These obligations are sometimes definitely and sometimes only generally stated in the franchise and require that the street railway furnish with a maximum degree of safety and comfort to the public adequate service upon the route or routes specified whenever there is a reasonable demand for service.

The immediate operating organization, which the management directs, is concerned in preparing and maintaining the track and structures for the actual movement of traffic, providing and maintaining the cars therefor, and finally the actual transportation of passengers, but the diverse nature of the duties connected with these operations make necessary many other subdivisions. For convenience these subdivisions are called departments. They are in fact groups of closely related duties which may be combined in practice under one head or which may be further subdivided.

The department with which the public is immediately in contact is that dealing with passenger transportation. This consists not only of the motormen and conductors, who operate the cars, but of the flagmen and switchmen who assist in giving the car the right-of-way, the supervisors, inspectors and checkers of the service, and the schedule makers and dispatchers, who determine where the service shall be placed. The choice and training of the men for the responsible positions of motormen and conductors require great care, and such

preliminary training involves substantial expense to the traction utility. Frequently, after such training has been well in progress, defects, tempermental and otherwise, are noted which make it inadvisable to place the prospective trainman in the public service and the cost of such training is completely lost.

Closely associated with the work of the transportation department, is that of the power plant department, which provides the electrical energy propelling the cars. Electrical energy cannot be economically stored and the power plants must therefore be in readiness to furnish it whenever and wherever it may be demanded. For this purpose, if the source of supply is steam power, boilers must be continuously fired, the generators and auxiliary apparatus must be operated and cared for, and the load dispatched where needed. Since much of the transportation service is furnished to sections of the city remote from the power plant, it is necessary to relay the current at high voltages to substations, which in turn supply the feeders that tap into the trolley system in their vicinity. A high degree of coördination must exist between the power plant and the remotely situated substations during the twenty-four hours of each day, and in case of mishap to generating apparatus, other means must be available for furnishing the necessary energy. The firemen, engineers, helpers and switchboard attendants, who perform this service, comprise an organization in which efficiency and discipline are essential qualifications.

Closely related to the power plant department is the operating organization which must devote its efforts to operating and maintaining the distribution system. The distribution system consists not only of the trolley or other contact which directly supplies energy to the motors of the cars, but also of the feeders and ground return wires and cables from and to the power plants and substations, together with their support by poles or other means, together with conduits and manholes. Owing to the wide geographical area over which this net work of wires and cables extends and the necessity of frequent inspection and repair, this department is one of the most important in the service. When a trolley wire breaks, the avoidance of not only the tie-up of traffic but the danger to the public necessitates prompt action in remedying the trouble. No fire department has more pressing and immediate duties to perform than those of the line patrol. This work requires a high degree of organization and careful training.

The way and structures department has charge of the roadway and track, the buildings, and the other permanent structures of the traction utility. The roadway and track are continually in need of repair and the utility's ability to render satisfactory service depends largely upon the work done by the engineers, road masters, and the score of other employes caring for the right-of-way. The property operated by this department constitutes the larger part of the capital investment and the permanence of these structures involves important engineering

problems, the proper solution of which has a material effect on future maintenance costs.

The duties of the equipment department are perhaps more numerous and involved than any of the parts of the operating organization heretofore discussed. The care of rolling stock requires not only periodic overhauling of motors, trucks, wheels, car bodies and car equipment, but the cleaning, lighting and heating of cars for daily operation. The investment in a single car is substantial and the percentage of time it is shopped has a material effect on cost of operation. The diversified work of the equipment department from forge to paint shop requires careful organization.

Associated with all of the operating departments is the work of purchasing and stores. The electric railway must have on hand a supply of operating materials and repair parts adequate to care for sudden and heavy demands. The investment in these supplies frequently runs into hundreds of thousands of dollars, and their economical purchase, care, and systematic disbursement are among the more important functions of the traction utility. The needs of operating, maintenance, and construction departments must be anticipated and supplied without delay as the public must be promptly served.

Associated also with all departments is the work of the accounting department, which cares for the accounts and statistics of the entire business and assembles the diversified records of transactions which have occurred throughout the system. Where the responsibility for particular work is shared jointly by several departments, the total cost of such work is determined in the accounting department. It is the accounting department also which furnishes the general management with an immediate record of the output or the amount and costs of public service rendered.

Since the traction business comes in contact daily with a large portion of the public and performs its work in the public streets, it is never free from legal difficulties. These may arise out of suits for damages, suits in re the right to operate, and cases before public service commissions. This work necessitates a carefully organized legal department, particularly skilled in the handling of legal problems affecting the traction utility.

The health and comfort of many employes, large numbers of whom have so specialized in their fields as to regard the work in which they are engaged as a life vocation, necessitates the organization of recreational activities, benefit measures, savings plans, etc. These are commonly classified under the general heading, "Welfare Activities," and are an important part of every large traction utility. The work of such a department requires doctors, nurses, permanent visiting committees, directors of amusement and other officials who, because of their large and diversified duties, cannot be engaged in other work. Necessarily these duties require a high degree of specialization.

A similar general department is that concerned with safety work. "Stop, Look and Listen," and "Safety First," are familiar warnings, but they are habitually disregarded by both the public and the employes. The great distress and expense involved because of avoidable accidents have made apparent the necessity of organizing and carrying on systematic plans of education and systematic installation and inspection of safety appliances.

The arrangement of these departmental duties in staff and line organization, and the inter-relation of responsibility developing with each such organization, depends in part upon the talents and specialized training of the executives available for the general direction of the work and may differ in various street railways.[1] The necessity of a smoothly working organization, both corporate and operating, with a minimum of detailed instruction and a maximum of efficient routine, is apparent in the successful operation of an electric railway. The development of such an organization is a gradual process, requiring much education and frequent elimination until individuals are found who are best suited to the particular tasks involved. The creation of a going concern, it is evident, involves considerable expense. The operation of that concern when it has been created is the chief element in the cost of service.

---

[1] Typical organization charts have been published from time to time in the Electric Railway Journal; among those of interest are the following:

| Company | Organization | Date | Volume, number and page | | |
|---|---|---|---|---|---|
| Sheboygan Light, Power & Railway Company | Complete organization | Feb. 13, 1909 | XXXIII | 7 | 272 |
| Michigan United Railways Company | Complete organization | April 29, 1911 | XXXVII | 17 | 738 |
| Waterloo, Cedar Falls & Northern Railway Company | Complete organization | Aug. 24, 1912 | XL | 8 | 278 |
| San Francisco-Oakland Terminal Railway Company | Complete organization | Dec. 6, 1913 | XLII | 23 | 1190 |
| San Francisco-Oakland Terminal Railway Company | Complete organization | April 16, 1914 | XLIII | 20 | 1086 |
| Southern Traction Company. | Complete organization | July 4, 1914 | XLIV | 1 | 6 |
| Chicago & West Towns Railway Company | Executive organization | Sept. 12, 1914 | XLIV | 11 | 470 |
| Public Service Railway Company | Maintenance of way and structures department | May 2, 1908 | XXXI | 18 | 715 |
| Metropolitan Street Railway Company (New York) | Maintenance of way and structures department | May 7, 1910 | XXXV | 19 | 817 |

| Company | Organization | Date | Volume, number and page | | |
|---|---|---|---|---|---|
| Public Service Railway Company | Maintenance of way and structures department | Oct. 7, 1911 | XXXVIII | 15 | 576 |
| Michigan United Railways Company | Track and roadway | Mar. 15, 1913 | XLI | 11 | 478 |
| New York State Railways Company | Maintenance of way | July 12, 1913 | XLII | 2 | 63 |
| Interborough Rapid Transit Company | Equipment department | Mar. 28, 1908 | XXXI | 13 | 478 |
| Massachusetts Electric Company | Equipment department | June 4, 1910 | XXXV | 23 | 971 |
| Brooklyn Rapid Transit Company | Mechanical department | Aug. 21, 1909 | XXXIV | 8 | 280 |
| Chicago Railways Company | Mechanical department | April 1, 1911 | XXXVII | 13 | 564 |
| Public Service Railway Company | Mechanical department | Oct. 7, 1911 | XXXVIII | 15 | 608 |
| Worcester Consolidated Street Railway Company | Mechanical department | April 6, 1912 | XXXIX | 14 | 568 |
| Metropolitan Street Railway Company (New York) | Electrical department | May 21, 1910 | XXXV | 21 | 897 |
| Public Service Railway Company | Distribution department | Oct. 7, 1911 | XXXVIII | 15 | 594 |
| Metropolitan Street Railway Company (New York) | Rolling stock and shops | April 2, 1910 | XXXV | 14 | 562 |
| Worcester Consolidated Street Railway Company | Car house | April 6, 1912 | XXXIX | 14 | 573 |
| Brooklyn Rapid Transit Company, J. C. Thirlwall | Maintenance shops (suggested) | Oct. 14, 1912<br>Oct. 26, 1912 | XL<br>XL | 11<br>16 | 406<br>911 |
| New York State Railways Company | Traffic department | Oct. 8, 1910 | XXXVI | 15 | 556 |
| Detroit United Railways Company | Traffic department | Oct. 8, 1910 | XXXVI | 15 | 576 |
| Metropolitan Street Railway Company (New York) | Transportation department | June 25, 1910 | XXXV | 26 | 1088 |
| Public Service Railway Company | Transportation department | Oct. 7, 1911 | XXXVIII | 15 | 614 |
| Public Service Railway Company | Transportation department | Feb. 21, 1914 | XLIII | 8 | 415 |
| Public Service Railway Company | Claim department | Oct. 7, 1911 | XXXVIII | 15 | 636 |
| West Jersey & Seashore Railway Company | Electrical division | July 1, 1911 | XXXVIII | 1 | 21 |
| Brooklyn Rapid Transit Company | Elevated railway division | Feb. 2, 1907 | XXIX | 5 | 170 |
| J. H. McGraw | Organization and team work | Feb. 28, 1914 | XLIII | 9 | 462 |

# PART II

## ELEMENTS OF COST

## CHAPTER III

### THE ANATOMY OF THE FIVE-CENT FARE

Proportionate Division of Five-Cent Fare,—— Street Railways of the United States, 1912, 1907 and 1902,—— Typical Urban Surface Railways,—— Elevated and Subway Lines,—— Proportionate Division of Expense, Labor and Material,—— The Street Car Nickel and the Jitney Nickel.—— Proportionate Division of Costs, Fixed and Variable,—— Proportionate Division of Costs, Terminal and Movement,—— Proportionate Division of Revenues and Expenses Throughout Day.

In previous chapters there has been discussed briefly and in an elementary way, the occasion for cost of urban passenger transportation service. It is essential before examining actual problems of cost analysis to have an accurate conception of the relative importance of the various elements of cost. Such a perspective may be obtained conveniently by reducing costs to terms of the five-cent fare or percentages of total operating expenses.

The proportionate division of the nickel can be treated only generally and as conditions and character of operation of each company may be expected to differ, the proportions are in many cases not even typical. They will serve, however, to convey the general impression which must be borne in mind in analyzing the elements of cost of service.

In order that reference may be made to census bulletins and published reports of certain companies, the following brief statement of the standard classification of accounts generally in use will be of interest.

There are five general heads under which transportation companies usually keep their accounts:

#### 1. Operating Revenue

This includes revenues of two types, those from *transportation* and *other revenues*. Under transportation revenue is included the earnings from handling passengers, baggage, special cars, mail, express, milk, freight, etc., while under other revenues are included advertising privileges, parcel room receipts, storage charges and some miscellaneous returns from rent, sale of power, etc. Taken together, the revenue shown under this general head, comprises all the revenues which the operating property or utility produces.

#### 2. Operating Expenses

Offsetting operating revenues are operating expenses, consisting of the expenses for the maintenance of tracks and equipment, the cost of obtaining business through advertising and special traffic

agents, the cost of power and of operating cars, and the general and miscellaneous expenses of operation.

The difference between the two amounts, *operating revenues* and *operating expenses*, is called *net operating revenue*. To this amount is added:

### 3. Miscellaneous Income

This income consists of interest on any securities which may be owned, the interest on bank balances, the rental of property, such as, for example, offices and stores in the company's buildings, or the rental of land which is owned and held, waiting the time when it may be needed for the operation of the railway. After this *miscellaneous income* has been added to *net operating revenue*, account is taken of certain other items known collectively as

### 4. Deductions from Income

The amounts here classified consist of interest paid on bonds of the company or on mortgages or other indebtedness, such as notes and current bank overdrafts, rentals paid for the use of property of other railway companies, taxes, whether levied by the city, state, or federal governments, and certain other miscellaneous amounts which must be deducted from income.

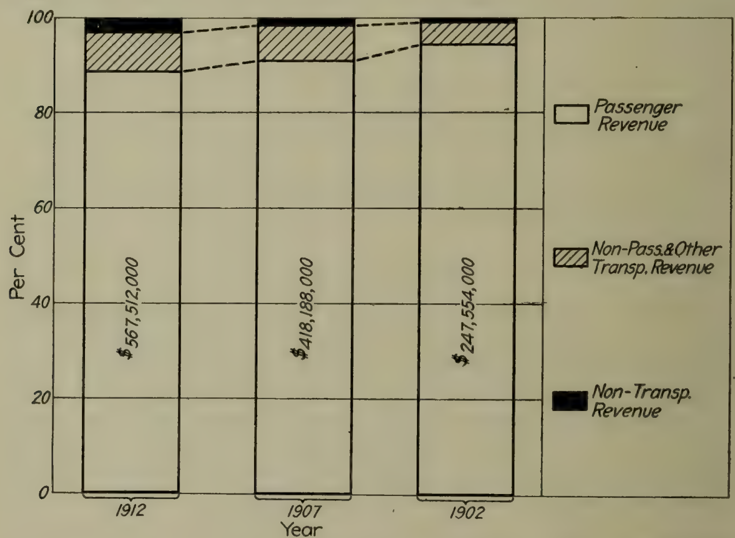



Fig. 2. Extent of Operating Revenue Derived From Different Sources, Electric Railways, the United States, U. S. Census, 1912.

After *miscellaneous income* has been added to *net operating revenue* and *deductions from income* taken from this sum, the amount which

is left is called *net income,* and out of this amount dividends are declared and the surplus if any carried to the balance sheet.

The only available figures of national scope covering the operation of electric railways are those collected at five-year intervals by the United States Department of Commerce, Bureau of the Census. The reports of the Census Bureau do not distinguish between urban and interurban lines but they are accurate and complete and are worthy of study. In the following paragraphs where figures do not refer to individual companies, they have been taken from the published reports of the Census Bureau.

Fig. 2 indicates the extent of operating revenue derived from different sources by all lines during the three years 1902, 1907, 1912. Considering urban systems alone, the percentage of passenger revenue is well over 95 per cent.

Fig. 3 is a graphical representation of the income account of the electric railways of the United States for the three years 1902, 1907 and 1912. In connection with the very small amount available for

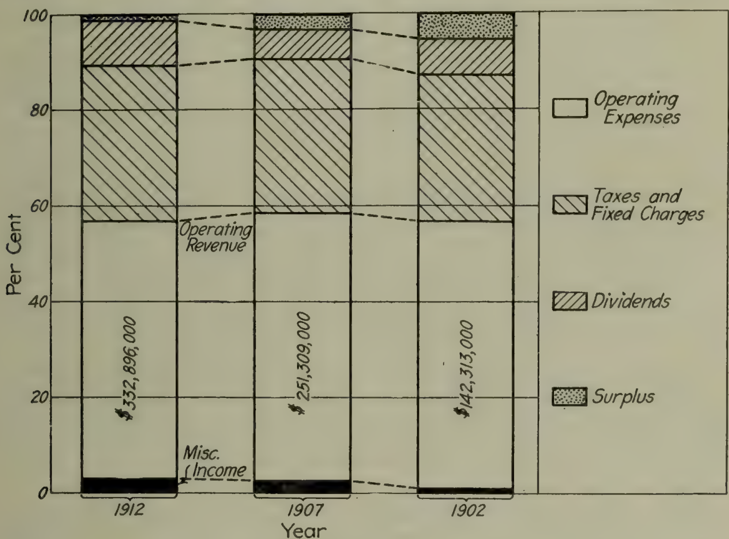



FIG. 3. INCOME ACCOUNT, ELECTRIC RAILWAYS OF UNITED STATES, U. S. CENSUS, 1912.

dividends as shown in Fig. 3, it is pertinent to point out that the average interest rate in 1912 was 4.90 per cent, and the average dividend rate was 2.64 per cent.[1] From Fig. 3, it is possible to divide the nickel fare as indicated in Table II.

[1] See Chapter VI — Actual Returns in the Traction Industry.

TABLE II.— DIVISION OF THE FIVE-CENT FARE

| | 1912 | | 1907 | | 1902 | |
|---|---|---|---|---|---|---|
| | Amount | Per cent | Amount | Per cent | Amount | Per cent |
| | (*Cents*) | | (*Cents*) | | (*Cents*) | |
| **Operating revenues — Total...** | **5 00** | **100.00** | **5 00** | **100.00** | **5 00** | **100.00** |
| Operating expenses........... | 2 84 | 56.82 | 2 92 | 58.48 | 2 84 | 56.81 |
| Fixed charges................ | 1 63 | 32.62 | 1 61 | 32.14 | 1 55 | 30.98 |
| Amount available for dividends and reserves............... | 53 | 10.56 | 47 | 9.38 | 61 | 12.21 |

Operating expenses, exclusive of fixed charges, may be subdivided under the groups of primary accounts provided in the classification of the Interstate Commerce Commission. The 2.84 cents required for operating expenses as shown above for 1912, may be divided under these headings as follows:[1]

TABLE III.— DIVISION OF OPERATING EXPENSES

| | GROUPS | Amount | Per cent of total |
|---|---|---|---|
| | | (*cents*) | |
| | **Operating expenses — Total.....................** | **2.840** | **100.00** |
| I | Maintenance of way and structures................ | 0.394 | 13.89 |
| II | Maintenance of equipment....................... | 0.344 | 12.12 |
| III | Power.......................................... | 0.486 | 17.12 |
| IV | Conducting transportation...................... | 1.142 | 40.19 |
| V | Traffic........................................ | 0.023 | 0.81 |
| VI | General and miscellaneous...................... | 0.451 | 15.87 |

Similar separations from the 1902 and 1907 Census returns corrected to conform to the revised classification of accounts, illustrate important tendencies of operating costs which are commented on in the following chapter.[2] The comparison of percentages of total operating expenses discloses the changes shown in Table IV.

With the increase in density of traffic the proportionate increase of maintenance expenses becomes more marked. When these expenses are measured in terms of car miles a considerable variation is found

[1] The above subdivision of the operating expenses is based upon the classification of accounts in effect from 1909 to 1914. The new system of accounts as prescribed by the Interstate Commerce Commission went into effect July 1, 1914, and was adopted by the American Electric Railway Accountants' Association October, 1914. This transferred the maintenance of the transmission system and of power plant buildings and structures from "Maintenance of Way and Structures" to "Power." The maintenance of power plant and substation equipment was similarly transferred from "Maintenance of Equipment" to "Power." Moreover, "Superintendence of Transportation" was subdivided into "Superintendence of Power" and "Superintendence of Car Operation." For further details, see "Uniform System of Accounts for Electric Railways," prescribed by the Interstate Commerce Commission, Issue of 1914.

[2] Chapter IV — Tendency of Operating Costs.

TABLE IV.— GROUPS OF EXPENSES IN PERCENT OF TOTAL

| | | 1912 | 1907 | 1902 |
|---|---|---|---|---|
| | **Operating expenses — Total** | (*Per cent*) 100.00 | (*Per cent*) 100.00 | (*Per cent*) 100.00 |
| I | Maintenance of way and structures | 13.89 | 13.21 | 10.48 |
| II | Maintenance of equipment | 12.12 | 12.53 | 11.72 |
| III | Power | 17.12 | 18.08 | 16.83 |
| IV | Conducting transportation | 40.19 | 38.66 | 42.83 |
| V | Traffic | 0.81 | 0.69 | 0.79 |
| VI | General and miscellaneous | 15.87 | 16.83 | 17.35 |
| | Number of operating companies | 975 | 939 | 799 |

between results in different parts of this country. Traffic expenses naturally fluctuate most widely followed by Power, Way and Structures, General and Miscellaneous, Conducting Transportation, and Maintenance of Equipment Expenses, in the order named.

Measured in terms of car miles, the cost of maintenance of way and structures increased 84 per cent in ten years, while the percentage increase of the other groups of operating expenses is for maintenance of equipment 43 per cent, for traffic 55 per cent, for conducting transportation 33 per cent and for general and miscellaneous expenses 31 per cent. Under conducting transportation, which increased as a whole 33 per cent per car mile, superintendence increased 60 per cent, power 46 per cent, and the operation of cars 25 per cent. The variation in these percentages indicates that the car mile is not a specific unit for the measurement of cost.

There are raised also a number of pertinent questions which, however, cannot be satisfactorily discussed in the light of available data. The very great increase in the cost per car mile of the maintenance of way and structures suggests, however, two things. First, that the heavy modern car, adopted for the purpose of giving the safest, most comfortable and fastest service possible, is placing a severe strain upon track that was designed for lighter equipment. It is likely also that the requirements as to the maintenance of paving and the

TABLE V.— GROUPS OF EXPENSES IN PERCENT OF TOTAL — STEAM ROADS

| | GROUPS | Per cent |
|---|---|---|
| | **Operating expenses — Total** | **100.00** |
| I | Maintenance of way and structures | 18.63 |
| II | Maintenance of equipment | 22.83 |
| III, IV | Power and conducting transportation | 51.66 |
| V, VI | Traffic and general | 6.88 |

cleaning and sprinkling of streets are reflected in the percentage of increase of these costs, which is over twice as great as that of the other operating expenses.

The comparable figures for steam roads for 1912, excluding switching and terminal companies, disclose the proportionate division, shown in Table V.

The groups of primary accounts shown in Table IV may be further subdivided into their component parts. Such a separation, showing the percentage relation of these to the total operating expenses for the year 1912 and as a proportion of the five-cent fare, is shown in Table VI.

TABLE VI.—DIVISION OF FIVE-CENT FARE BETWEEN ACCOUNTS AND GROUPS OF ACCOUNTS

| | ITEM | Per cent total operating cost | Distribution of five cent fare |
|---|---|---|---|
| | **Operating Expenses — Total** | **100.00** | **2.840** |
| I | **Way and Structures — Total** | **13.89** | **0.394** |
| | Superintendence | 0.80 | 0.023 |
| | Maintenance of way | 9.39 | 0.266 |
| | Maintenance of electric lines | 1.72 | 0.048 |
| | Buildings and structures | 0.83 | 0.024 |
| | Depreciation of way and structures | 1.15 | 0.033 |
| II | **Equipment — Total** | **12.12** | **0.344** |
| | Superintendence | 0.52 | 0.015 |
| | Maintenance of power equipment | 1.17 | 0.033 |
| | Maintenance of cars and locomotives | 5.27 | 0.150 |
| | Maintenance of electrical equipment of cars and locomotives | 3.07 | 0.087 |
| | Miscellaneous equipment expenses | 0.95 | 0.027 |
| | Depreciation of equipment | 1.14 | 0.032 |
| III | **Power — Total** | **17.12** | **0.486** |
| | Power plant employes | 1.97 | 0.056 |
| | Substation employes | 0.57 | 0.016 |
| | Fuel | 6.27 | 0.178 |
| | Other supplies and expenses | 0.63 | 0.018 |
| | Power purchased | 7.63 | 0.217 |
| | Power exchanged | 0.05 | 0.001 |
| IV | **Conducting transportation — Total** | **40.19** | **1.142** |
| | Superintendence | 2.22 | 0.063 |
| | Conductors and motormen | 30.54 | 0.867 |
| | Miscellaneous transportation expenses | 7.43 | 0.211 |
| V | **Traffic — Total** | **0.81** | **0.023** |
| VI | **General and Miscellaneous — Total** | **15.87** | **0.451** |
| | General expenses | 5.96 | 0.169 |
| | Injuries and damages | 6.45 | 0.183 |
| | Insurance | 0.98 | 0.028 |
| | Stationery and printing | 0.34 | 0.010 |
| | Store and stable | 0.63 | 0.018 |
| | Rent of tracks and terminals | 1.14 | 0.032 |
| | Rent of equipment | 0.37 | 0.011 |

The percentage relation of the most important of these accounts to the other items of expense entering into their respective groups is shown in Fig. 4.

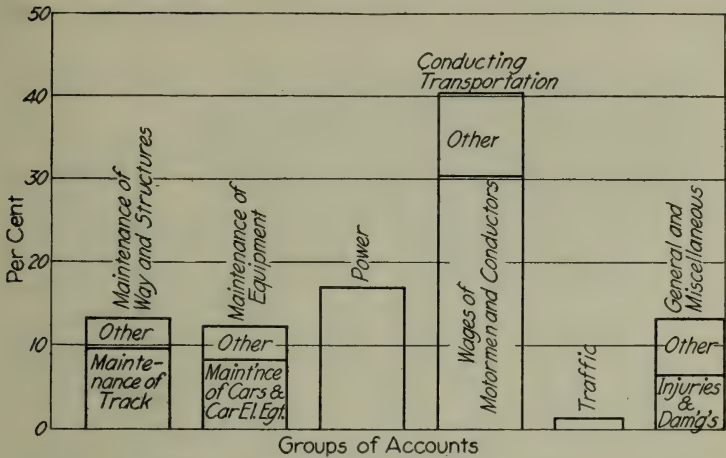



FIG. 4. OPERATING EXPENSES BY GROUPS OF ACCOUNTS — ELECTRIC RAILWAYS OF THE UNITED STATES — U. S. CENSUS, 1912.

From Fig. 4 it is seen that the labor cost constitutes a large proportion of the total expense and this is also apparent from the following analysis of 1912 Census figures:

TABLE VII.— DISTRIBUTION OF OPERATING EXPENSES

| ITEM | Per cent of total |
|---|---|
| **Operating expenses — Total** | **100.00** |
| Except labor | 39.67 |
| Labor — Total | 60.33 |
| Salaries — Total | 7.79 |
| Officers | 1.73 |
| Managers | 1.62 |
| Clerks | 4.44 |
| Wages — Total | 52.54 |
| Conductors | 14.15 |
| Motormen | 14.55 |
| Others | 23.84 |

The analysis of the Census figures as has been pointed out is only of general interest. The figures comprise urban and interurban electric railways and include subway, elevated and surface urban systems. The analysis of the figures of individual companies may be expected to vary widely. Fig. 5 discloses the division of the nickel for seven typical urban systems. Fig. 6, compares published results of the

analysis of the five-cent fare upon typical elevated, subway and surface lines.

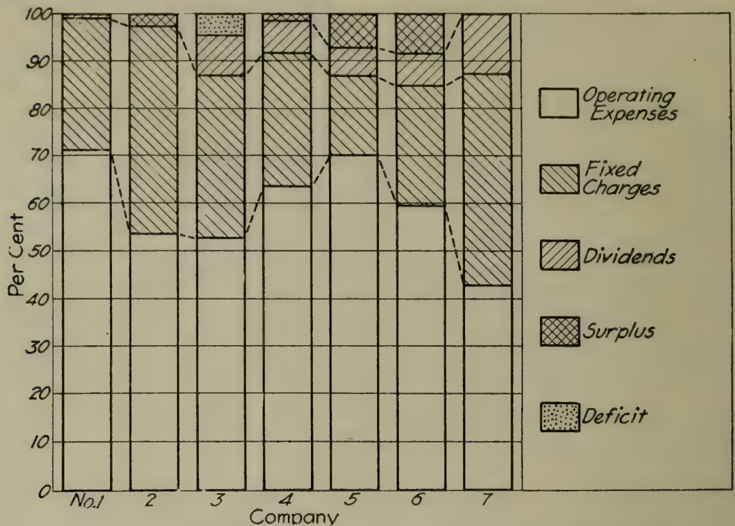



FIG. 5. DISPOSITION OF REVENUE — TYPICAL COMPANIES.

The comparison of the New York Subway and Elevated figures with the average of the United States Census for 1912, disclose the following differences:

TABLE VIII.— NEW YORK SUBWAY AND ELEVATED COMPARED WITH AVERAGE OF ALL LINES IN THE UNITED STATES.

| ITEM | United States census, 1912 | New York | |
|---|---|---|---|
| | | Subway | Elevated |
| | (Cents) | (Cents) | (Cents) |
| **Total operating revenues** | [1]5.000 | 4.995 | 5.006 |
| Operating expenses | 2.840 | 3.252 | 3.160 |
| Maintenance of way, structures and equipment | 0.738 | 0.561 | 0.624 |
| Power and traffic, conducting transportation | 1.651 | 0.933 | 1.295 |
| General and miscellaneous | 0.451 | 0.208 | 0.185 |
| Fixed charges | 1.630 | 1.550 | 1.056 |
| Amount available for dividends and reserves | 0.530 | 1.743 | 1.846 |

[1] Based on an assumed five-cent fare for purposes of comparison.

Various interesting studies have been made of the anatomy of the five-cent fare. The Portland Railway, Light and Power Company

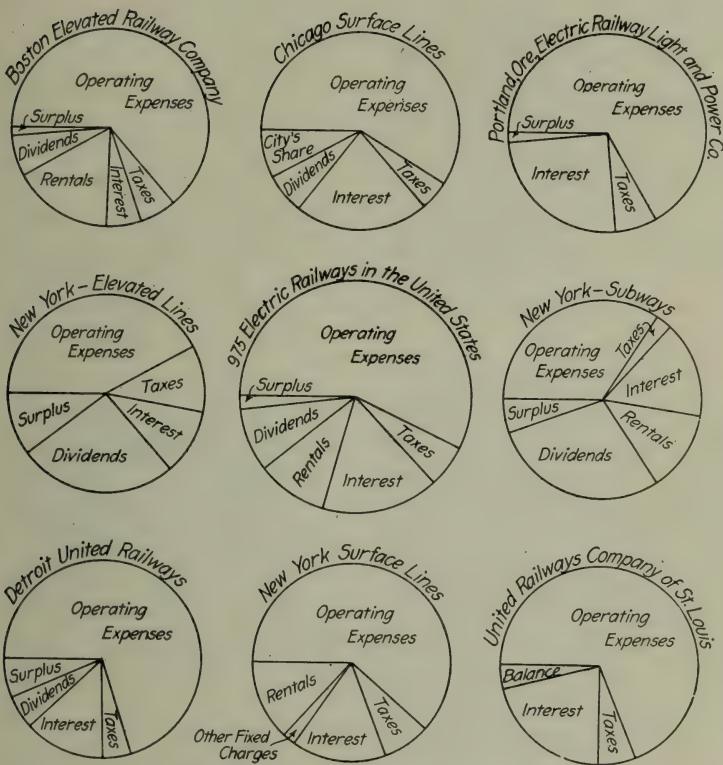



FIG. 6. ANALYSIS OF THE FIVE-CENT FARE.[1]

[1] These diagrams have been compiled from the following sources: New York — Interborough Rapid Transit Co., surface, elevated, subway; *Times Annalist*, Aug. 23, 1915 — figures for year ended June 30, 1913.

Portland Electric Railway, Light & Power Co., *Electric Railway Journal*, May 25, 1912 — figures for 1911.

Boston Elevated Railway Co., statement by Gen. Wm. A. Bancroft, President, to Committee on Metropolitan Affairs — Massachusetts Legislature. Figures for year ended June 30, 1914.

Detroit United Railways, *Electric Service*, Aug. 5, 1913, figures for year ended June 30, 1913.

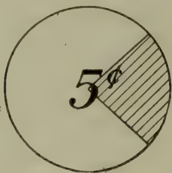
Chicago Surface Lines, *Chicago Herald*, June 18, 1915, figures for year ended Jan. 31, 1915 (taken from report of Board of Supervising Engineers.)

has published a comparison of the jitney nickel and the street railway nickel.[1] A number of devices have been used to enable railway companies to present to their patrons an analysis of expenditures in such

[1] From "*Watts Watt.*" May 14, 1915

**THE STREET CAR NICKEL**
(Chart below is based on 1914 operation)

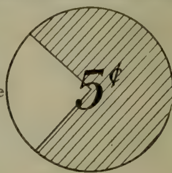
This Part Stays Here




This Part Is Spent Elsewhere

**THE JITNEY NICKEL**
(Chart below is based on best available data from several sources here and elsewhere)

This Part Stays Here




**This Part Is Expended Elsewhere**

**The Part That Stays Here**

I.— The Street Car company does not get a whole nickel. Twenty-eight per cent of it, or 1.4 cents, goes back to the public as a rebate in the form of commutation tickets, free tickets to city employes, such as policemen and firemen and for transfers, so for each passenger carried the Company only gets 3.6 cents. On the other hand, the jitney gets the whole nickel with no reductions of any kind.

II.— **Wages** alone are 41 per cent of this 3.6 cents, or more than the entire portion of the jitney nickel left in Portland.

III.— **Taxes, Bridge Rentals and Paving Expenses** consume a big part of the street car fare.

IV.— Then there is the outlay for **Damages, Supervision and other Local Expenses,** all of which stays here; also

V.— The portion of **Power Cost** representing **Wages, Wood Fuel** and **Local Supplies,** and

VI.— **Depreciation,** that part of which includes local supplies and local labor.

I.— **Garage expenses** and such repairs as can be made locally.

II.— **Interest** (if venture is not financed by automobile company or other outside interests).

III.— **License fees.**

IV.— **Damages** (in case victims succeed in recovering anything).

V.— **Wages,** when anything is left after other necessary expenses are paid. The fact that there are 35 per cent fewer jitneys in operation now than 60 days ago is evidence that the wages earned by the jitney operators are not sufficient to make the business attractive in by far the majority of cases. The City Hall records prove this. Very few of the original jitney drivers are in business today. The fact that new ones have taken their place simply proves P. T. Barnum's famous statement.

**The Part Spent Elsewhere**

I.— **Interest** on street car investment. Nothing could please the Old Reliable Service Company more than to find Oregon money seeking investment in this Company. Invitation to Oregon money has been and is constantly open to such purposes. Oregon money as a rule seeks more profitable investment than that permitted to the Public Utilities. And, so, the Eastern investor who is content with more modest interest return, comes to Portland's aid and that of the surrounding community by furnishing nearly all the funds required by the Old Reliable Service Company and other similar Public Utilities.

II.— **Material** manufactured elsewhere takes a small portion of the nickel.

III.— **Remaining items** entering into Power Cost.

IV.— **Depreciation,** that part which includes those things which cannot be purchased or made here.

**THREE-FOURTHS OF THIS NICKEL IS REINVESTED IN PORTLAND.**

I.— **Little Johnnie Rockefeller** gets a big slice of the nickel for **gasoline** and **oil.**

II.— **The Rubber Barons** come in for another fat part of the coin (there are no tire factories in this locality).

III.— **Repair parts** bought from the Eastern auto manufacturers absorb a little more.

IV.— **Depreciation.** This is one of the rocks on which the big bulk of the jitney wild-catters have gone broke. Usually, old secondhand machines are purchased on the installment plan and are operated until they are in the last stages of "consumption," and then they are "scrapped" and sent to the "Old Ford's Home" and the jitney man must buy another or go out of business.

**ONLY ONE-FOURTH OF THIS NICKEL STAYS IN PORTLAND.**

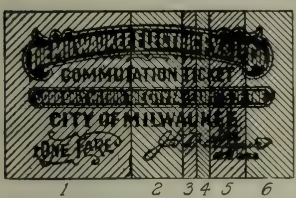
form as will be effective in disclosing the disposition of the fare. A somewhat unusual graphical method is that employed by The Mil-material and sundries.[1]

Aside from a separation of operating expenses in accordance with the standard classification of accounts, a separation may be made between the costs properly chargeable to operation during the different hours of the day. Such a separation depends in part upon the amount of traffic at any hour of the day since there are certain items of expense which vary with the amount of traffic. These are ordinarily called "variable" expenses in distinction to the so-called "fixed" expenses or those expenses which occur whether or not the property is being operated.[2] "Fixed" expenses correspond in general to those known as "terminal" expenses in steam road operation. Such a separation for a typical urban street railway system follows:

---

[1] From "*Of Public Interest*," June 24, 1915:

THIS CHART SHOWS WHERE THE FARES GO




How many passengers, when they drop their bit of pasteboard into the fare box, realize how it is cut up and divided before all the expenses of running a street railway are paid?

It is to be remembered in this connection that the average fare paid by the passengers on the Milwaukee cars is 4.16 cents and that only every seventh or eighth passenger drops in a nickel, or a cash fare.

The average fare for all passengers, including those who ride on a transfer, is less than three cents, in fact, was 2.98 cents in 1914.

Naturally when a passenger boards a car the first thing he thinks of is the person in sight, the conductor. Then comes the motorman. They get their share of the fare, but they are not all the labor that comes in for a part of the ticket value. There are those who keep the cars clean and in repair, those who repair the track, who fire the boilers and tend the machinery in the power plants, who string the wires and keep them in shape, who sprinkle the tracks or shovel the snow, who pave the track zone, and do other necessary work.

For labor — the first section of the ticket chart above — there goes nearly one-half of each fare — 1.81 cents — all of it staying in Milwaukee and being re-expended here for rents, clothing, food, fuel and other living expenses.

Then there are the supplies — No. 2 on the chart. This Company must buy a long list of articles in the course of a year. Over 26,000 different items are carried in its store rooms. Some of these supplies come in single pieces, some in 1,000 ton lots. They take 0.71 cents, most of it being spent in Milwaukee.

Then there are accidents — No. 3 on the chart. There have not been so many since systematic safety work was started, but this item takes one-fifth of a cent from each fare.

In every large business there are accounts too small to detail, but which in the aggregate make a considerable sum. These cover such items as rent of certain pieces of track and general expenses not covered by other classifications. They — No. 4 — also take one-fifth of a cent.

For taxes — No. 5 — each passenger contributes one-half of a cent every time he rides

Then we come to what is left — nearly three-fourths of a cent — as shown in scetion 6. This must do everything else. It must cover special funds for replacements and renewals, that is, all items taken out of earnings, including interest on indebtedness, such as bonds and notes, and provide the emergency reserves. The remainder goes to the stockholders, those who have put their money into the enterprise — many of them men and women of this community — in the hope that Milwaukee would appreciate their confidence and support the industry.

[2] For further discussion of "fixed" and "variable" expenses, see Chapter VII — Units of Comparison. For methods of the analysis of cost during various hours of the day, see Chapter XVI — The Cost of Complying with Service Standards.

TABLE IX.— SEPARATION OF TOTAL OPERATING EXPENSES AND GROSS EARNINGS BY PERIODS OF DAY.

| ITEM | 24 hours | A. M. | | | | | | P. M. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12–5 | 5–6 | 6–7 | 7–8 | 8–9 | 9–4 | 4–5 | 5–6 | 6–7 | 7–8 | 8–12 |
| Total expenses | 100.00 | 1.7 | 2.1 | 7.2 | 7.6 | 6.4 | 27.1 | 6.7 | 11.5 | 10.8 | 5.0 | 13.9 |
| Gross earnings | 100.00 | 1.0 | 2.0 | 8.5 | 8.7 | 6.5 | 26.8 | 7.0 | 11.5 | 10.5 | 5.5 | 12.0 |

The five-cent fare may be further analyzed as between costs dependent upon distance traveled or "movement" costs and those independent of distance traveled or "terminal" costs.[1] A detailed description of the methods of making these separations is contained in a subsequent chapter.[2]

[1] Mr. C. N. Duffy, in his contribution to work of the Committee for Determining the Proper Basis of Rates and Fares, has pointed out the relative proportions of these various cost items in the Milwaukee case, as follows:

| ITEM | Per cent of total | |
|---|---|---|
| (A) Expenses which exist even though there is no traffic (terminal cost): | | |
| (1) Expenses varying with the miles of track operated | 2.3 | |
| (2) Demand expenses at power plant | 3.0 | |
| (3) Depreciation due to causes other than traffic | 3.5 | |
| | | 8.8 |
| (B) Expenses proportional to traffic (terminal or movement cost dependent upon load factor): | | |
| (1) Expenses varying with the car miles run | 7.9 | |
| (2) Expenses varying with the car hours run | 24.3 | |
| (3) Output expenses at power plant | 5.9 | |
| (4) Depreciation due to traffic | 9.5 | |
| (5) Return upon investment | 24.7 | |
| | | 72.3 |
| (C) Expenses proportional to number of passengers (movement cost): | | |
| (1) Expenses varying with the number of passengers carried | ........ | 6.7 |
| | | 87.8 |
| Administrative expense burden | ........ | 12.2 |
| Total cost of service, exclusive of any prorating of administrative expense burden | ........ | 100.0 |
| Total cost of service after adding prorating of administrative expense burden: | | |
| (A) Expenses which exist even though there is no traffic (terminal cost) | | 10.0 |
| (B) Expenses proportional to traffic (terminal or movement cost dependent upon load factor) | | 82.4 |
| (C) Expenses proportional to number of passengers (movement cost) | | 7.6 |
| Total cost of service, including prorating of administrative expense burden | | 100.0 |

C. N. Duffy, "Effect of Load Factor on the Cost of Electric Railway Passenger Service," Fourth Annual Mid-Year Conference, American Electric Railway Association, 1913.

[2] Chapter XVII — Units of Comparison.

# CHAPTER IV

## TENDENCY OF OPERATING COSTS

Growth of the Industry,—— Increase in Service Furnished Due to Increase of Area Served and Consolidation,—— Increased Length of Ride For the Single Fare,—— Decrease in Receipts per Passenger due to Increased Use of Transfers,—— Effect of Changes in Speed, Type of Equipment and Frequency of Service on Cost, —— Increase of Municipal Requirements,—— Increase in Unproductive Investment,—— The Decreased Purchasing Power of the Five-Cent Fare and the General Increase in the Cost of Money, Labor and Material,—— General Conclusions.

The past twenty years have witnessed great changes in the electric traction industry. Constant demands for increased quality and quantity of service have necessitated most careful attention to the physical plant. In an attempt to increase speed of transportation, high powered motors and air brakes have been installed to minimize the time lost in making stops. Much attention has been given to the speed of loading and there have been developed various types of low-step cars with a number of combinations of entrances and exits located at various places in the cars. Seats, heating and ventilating appliances, illumination, and other factors affecting the comfort of passengers have received careful consideration, and show a great advance over cars in service a decade ago. High speeds and heavy cars have necessitated an entirely different type of track, the cost of which much exceeds that in service in the past and the riding qualities of which are immeasurably superior. In this period, a great deal of power plant equipment has been superseded and single units are now in evidence of a capacity exceeding complete installations a few years ago.

In addition to these changes which will be commented upon more in detail in the following paragraphs, there have been perfected and placed in operation double-deck cars, storage battery cars and various other products of technical science in an effort to meet the increasing demands for service out of a limited revenue. For a detailed discussion of these changes, the reader is referred to "A Study of the Technical Advances in the Industry" by T. C. Martin, Expert Special Agent, Bureau of the Census.[1]

Aside from the technical advances in the industry, there has been a large growth in electric railway mileage, in the number of cars in use, in the daily car mileage, in the number of revenue passengers carried, and in the amount of the investment in the industry. These changes are briefly summarized in Table X based on material contained in a recent Bulletin of the United States Department of Commerce, Bureau of the Census, dealing with street and electric railways.[2]

---

[1] 1912 Bulletin of the U. S. Department of Commerce, Bureau of the Census—"Street and Electric Railways" page 327.
[2] Ibid, p. 184.

TABLE X — CHANGES IN THE ELECTRIC TRACTION INDUSTRY

| Item | 1912 | 1907 | 1902 | 1890 | Per cent of increase, 1902–1912 |
|---|---|---|---|---|---|
| Number of companies | 1,260 | 1,236 | 987 | 789 | 27.7 |
| Operating | 975 | 945 | 817 | 769 | 19.3 |
| Lessor | 285 | 291 | 170 | 20 | 67.6 |
| Miles of line | 30,437.86 | 25,547.19 | 16,645.34 | 5,783.47 | 82.9 |
| Miles of track | 41,064.82 | 34,381.51 | 22,576.99 | 8,123.02 | 81.9 |
| Operated by: | | | | | |
| Electricity | 40,808.39 | 34,037.64 | 21,901.53 | 1,261.97 | 86.3 |
| Other | 256.43 | 343.87 | 675.46 | 6,801.05 | —62.0 |
| Cost of construction and equipment | $4,596,563,292 | $3,637,668,708 | $2,167,634,077 | $389,357,289 | 112.1 |
| Number of employees | 282,461 | 221,429 | 140,769 | 70,764 | 100.7 |
| Number of passenger cars | 76,162 | 70,016 | 60,290 | 32,505 | 26.3 |
| Number of revenue passengers | 9,545,554,667 | 7,441,114,508 | 4,774,211,904 | 2,023,010,202 | 99.9 |
| Number of revenue passengers per mile of track | 232,556 | 216,522 | 212,217 | [1] 249,047 | 9.6 |

[1] Decrease in traffic density from 1890 to 1902 was due to the great expansion of electric lines, the trackage increase being relatively greater than the growth in passenger traffic.

While these are striking figures, there have been other tendencies of even greater significance which must not be lost sight of. One of these has been the growth in the length of ride for one fare which is due to the growth in area of urban communities. This tendency of American cities to expand in area and of resident districts to develop at some distance from the traffic center of the city is evident from the careful analysis by George H. Davis,[1] of conditions affecting

[1] "Owing to the rapid growth of cities the majority of companies are facing a definite problem resulting from the constant increase of city areas, the extension of their traffic systems and the expansion of five-cent fare limits to correspond with corporate limits. . . . It is axiomatic that there is a limited distance to which a five-cent fare can be applied profitably. A city might annex a neighboring city 100 miles distant, and through its franchise provisions demand a five-cent fare. The question is one that must be settled in a manner to result in profitable operation."

"Adjustment of American Street Railway Rates to the expansion of City Areas" — an address by Mr. George H. Davis, of Ford, Bacon & Davis, January, 1911—Mid-Year Conference, American Electric Railway Association.

The data upon which Mr. Davis bases his conclusions may be summarized as follows:

ESTIMATED AREA OF CITY DEVELOPED AND SERVED

| COMPANY | SQUARE MILES | | | | | Increase 1910 over 1900 per cent | Increase 1900 over 1870 per cent |
|---|---|---|---|---|---|---|---|
| | 1870 | 1880 | 1890 | 1900 | 1910 | | |
| 4 | 6.00 | 9.00 | 16.00 | 21.50 | 24.00 | 12 | 258 |
| 5 | 7.50 | 9.50 | 10.20 | 11.40 | 16.40 | 44 | 52 |
| 6 | ...... | ...... | 37.95 | 43.38 | 59.52 | 37 | ....... |
| 8 | 1.67 | 2.78 | 4.20 | 9.96 | 14.48 | 45 | 496 |
| 9 | ...... | ...... | 6.73 | 7.80 | 13.26 | 70 | ....... |
| 12 | ...... | ...... | 11.00 | 12.00 | 15.50 | 30 | ....... |
| 13 | 0.47 | 0.47 | 12.04 | 12.04 | 20.00 | 66 | 2462 |
| 14 | ...... | ...... | 9.00 | 18.00 | 25.00 | 40 | ....... |
| 16 | 8.00 | 8.50 | 11.45 | 18.45 | 11.45 | *D* 38 | 131 |

*D* — Decrease.

AREA OF CITY WITHIN CORPORATE LIMITS

| COMPANY | SQUARE MILES | | | | | Increase 1910 over 1900 per cent | Increase 1900 over 1870 per cent |
|---|---|---|---|---|---|---|---|
| | 1870 | 1880 | 1890 | 1900 | 1910 | | |
| 2 | 23.11 | 27.76 | 27.76 | 28.06 | 41.35 | 47 | 12 |
| 3 | 10.95 | 13.67 | 20.16 | 27.26 | 39.72 | 46 | 149 |
| 4 | 10.25 | 14.75 | 20.50 | 21.50 | 24.00 | 12 | 110 |
| 5 | 16.36 | 18.16 | 18.16 | 18.94 | 23.40 | 23 | 16 |
| 6 | 20.99 | 31.96 | 108.44 | 108.45 | 108.44 | ...... | 417 |
| 7 | ...... | ...... | 15.00 | 28.00 | 33.70 | 28 | ....... |
| 8 | 2.78 | 4.28 | 5.60 | 16.60 | 19.30 | 16 | 497 |
| 9 | 18.70 | 19.00 | 19.20 | 19.50 | 19.50 | ...... | 4 |
| 10 | ...... | ...... | 8.50 | 12.20 | 25.60 | 110 | ....... |
| 11 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | ...... | ....... |
| 12 | 17.50 | 17.50 | 12.50 | 12.50 | 17.50 | 40 | [6] 29 |
| 13 | 0.47 | 0.47 | 12.04 | 12.04 | 50.10 | 300 | 2462 |
| 14 | 1.81 | 1.81 | 3.96 | 3.96 | 3.96 | ...... | 119 |
| 15 | 129.50 | 129.50 | 129.50 | 129.50 | 129.50 | ...... | ....... |
| 16 | 8.00 | 8.50 | 11.45 | 18.45 | 11.45 | *D* 38 | 131 |

*D* — Decrease.

(Footnote pg 37, Continued)

Length of Longest Ride Possible for One Fare

| Company | Miles | | | | | | | | | | | | Increase 1910 over 1900 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1890 | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | (Per cent) |
| 2 | ...... | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | 14.37 | ......... |
| 3 | ...... | ...... | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 13.50 | 13.50 | 13.50 | [1]........ |
| 4 | ...... | 10.00 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 12.14 | 1.21 |
| 6 | 6.00 | ...... | ...... | ...... | ...... | ...... | .... | ...... | ...... | ...... | ...... | 17.70 | [2]........ |
| 8 | ...... | 9.64 | 9.64 | 9.64 | 9.64 | 9.64 | 12.12 | 12.12 | 12.12 | 15.23 | 15.23 | 16.14 | 67.42 |
| 12 | ...... | 6.50 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 7.76 | 19.38 |
| 13 | ...... | 7.30 | 7.30 | 13.60 | 13.60 | 13.60 | 13.60 | 13.60 | 13.60 | 13.60 | 13.60 | 13.60 | 86.30 |
| 16 | ...... | 6.00 | 6.00 | 7.00 | 7.00 | 8.79 | 8.79 | 8.79 | 8.79 | 8.79 | 8.79 | 8.79 | 46.50 |

[1] Increase 1910 over 1901, 8 per cent.

[2] Increase 1910 over 1890, 195 per cent.

Comparable data in these tables indicate that during the ten years from 1900 to 1910, the area within the corporate limits of 15 cities had increased 18.3 per cent; the area developed and served in nine cities had increased 29.7 per cent; and the length of the maximum ride for one fare had increased 43.8 per cent.

16 companies having annual gross earnings in most instances in excess of $1 000 000, and representing geographically and politically practically all sections of the United States and all conditions of operation. The study shows that approximately 50 per cent of these companies were forced by franchise provisions to extend their 5-cent fare limits to coincide with the extension of city limits, that the increase in the length of the longest ride possible for one fare during the period from 1890 to 1910, has been material,[1] and that the density of traffic has not kept pace with the expansion of city boundaries.

The increase in the length of ride for one fare has been due not only to the expansion of city areas, but also to the consolidation of companies operating within the same area. This is brought out by the reports of the United States Bureau of the Census and is the conclusion of those who have had an opportunity to observe the tendencies of the industry.[2]

In passing, it may be pointed out that while consolidation has immensely benefited those served, its effect on capital values has not been accorded general consideration. Certainly those who brought it about are entitled to have the costs of consolidation, among which is the invisible but very real cost of acquiring the going value of the units combined, recognized as legitimate elements of value.

Fig. 7 shows the rapid increase in number of the large roads in the United States, brought about largely through consolidation. These consolidations have been accompanied by a large increase in the length of the average road. This is shown in Table XI.

TABLE XI — GROWTH OF AVERAGE ELECTRIC RAILWAY

| YEAR OF CENSUS | Miles of track | Miles of line |
|---|---|---|
| 1912 | 42.12 | 31.22 |
| 1907 | 36.38 | 27.03 |
| 1902 | 27.63 | 20.37 |
| 1890 | 10.56 | 7.52 |

[1] Mr. Davis states: " There appears to be very little definite information regarding the length of the average passenger ride . . . but available data, however, would indicate that this is from 2 to 4.5 miles, an average of approximately three miles."

[2] H. W. Blake, Editor *Electric Railway Journal* — The Problem of the Five-Cent Fare— Report twenty-eighth annual meeting The Street Railway Association of the State of New York, page 38.

"The tendency towards the consolidation of all of the electric railway companies in one city which was initiated on a large scale first in Boston soon extended during the early nineties to many other large cities, until in 1900, there were few cities in the country in which more than one company was giving purely city service. Before these consolidations, passengers in most cases had to pay an additional fare every time they changed from one road to another. After the consolidations, either by agreement with the municipality, by charter or by statute, a single fare was sufficient to purchase a ride from any given point within the city limits to any other point on the same system, and as extensions were built, still longer rides became available."

Thomas C. Martin, Secretary, National Electric Light Association—Technical Advances in the Street and Electric Railway Industry — 1912 Bulletin of the U. S. Bureau of the Census, page 327.

"The small increase in the number of operating and lessor companies compares strikingly, for example, with the high percentages of gain in plant equipment, the use of electrical energy, the number of passengers carried, the use of water power and the employment of electric locomotives in street railway service. Here is evidence of the natural tendency toward the grouping of properties into one unified system. . . ."

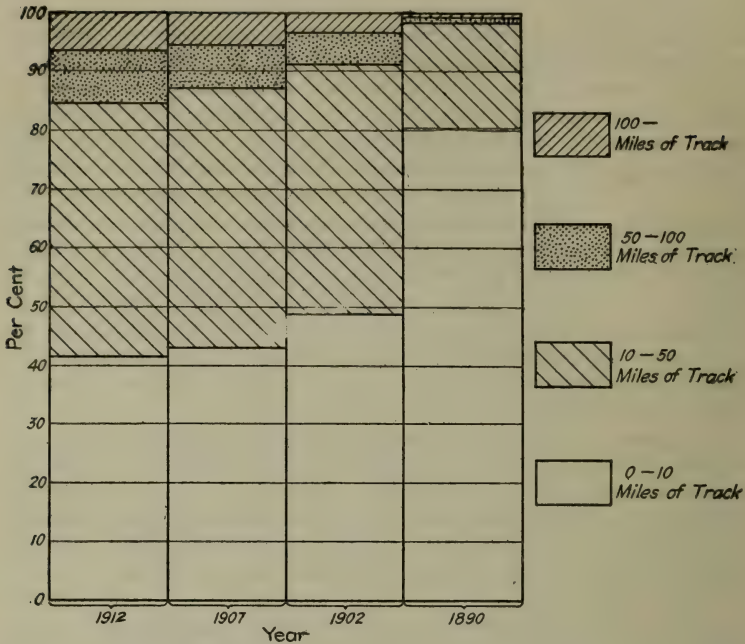



FIG. 7. INCREASE IN NUMBER OF LARGE ELECTRIC RAILWAYS IN THE UNITED STATES.

The comparative size of operating companies is also shown in the following table disclosing the average mileage, and the number of passenger cars, car miles operated, revenue passengers and employes per system:

TABLE XII — COMPARATIVE SIZE OF OPERATING COMPANIES

| CENSUS | Miles of track | Passenger cars | Passenger car miles | Revenue[1] passengers | Number of employes |
|---|---|---|---|---|---|
| 1912 | 42.12 | 78 | 1,938,202 | 9,810,436 | 290 |
| 1902 | 27.63 | 74 | 1,382,842 | 5,886,821 | 171 |
| 1890 | 10.56 | 42 | ........ | 2,630,702 | 92 |
| *Per Cent of Increase* | | | | | |
| 1890–1902 | 161.6 | 76.2 | ........ | 123.8 | 92.4 |
| 1902–1912 | 52.4 | 5.4 | 40.2 | 66.7 | 63.8 |
| 1890–1912 | 298.9 | 85.7 | ........ | 272.9 | 215.2 |

[1] "The increase in passengers carried is also much greater than that in car mileage, a fact due to the higher density of travel within cities and to the falling off in new construction not only within city limits but also in suburban and rural territory where the trolley is more or less cf a competitor with steam roads. Both contestants for transportation patronage in the five years seem to have suffered in some way from difficulty in raising new capital, smaller income from larger travel, and lack of the rapid expansion associated with earlier periods . . . Due to this inadequacy of the service *created* apparently by *discouragement* of *enterprise*, there have resulted a loss of time, a lower land value of suburbs, a lesser tax assessment, and a greater congestion of population paying high rent for less desirable homes, which if totalized and capitalized would represent a far greater sum than would have been necessary to create these facilities and pay a fair return."

T. C. Martin — Technical Advances in Street and Electric Railway Industry — 1912 Bulletin, U. S. Bureau of Census, p. 327.

While recent traction surveys have determined the average length of haul per passenger on urban transportation systems, data are not available which will permit a comparison of conditions as found with those previously existing. It may be safely concluded, however, that the average length of ride has expanded with the maximum permitted length of ride for a single fare as pointed out in the Davis studies. It is pertinent to note in this connection, the increase in average length of ride in New York City as computed from current records of tickets sold at each station on the subway lines of the Interborough Rapid Transit Co., by the Public Service Commission for the First District of New York.[1]

Table XIII — Average Length of Ride in Miles — New York Subway

| Year | Fiscal Year | Month of | | | |
|---|---|---|---|---|---|
| | | January | April | July | October |
| 1908 | ........ | 4.51 | ........ | 5.66 | ......... |
| 1909 | 5.41 | 5.10 | ........ | 5.81 | ......... |
| 1910 | 5.55 | 5.31 | 5.49 | 6.01 | 5.70 |
| 1911 | 5.59 | 5.42 | 5.51 | 6.09 | 5.70 |
| 1912 | 5.74 | 5.44 | 5.65 | 6.15 | 5.80 |
| 1913 | 5.80 | 5.61 | 5.72 | 6.20 | 5.83 |

Not only does the passenger of today receive a longer ride for one fare than in previous years, but the gross receipts per passenger have been steadily decreasing as the number of transfer passengers have increased. The cost of the extension of the transfer privilege will be discussed in Chapter XV but it is pertinent to point out in this connection, as is done in Fig. 8, the extent of such increases and their effect on the gross receipts per passenger.[2]

The constantly growing length of ride for one fare due both to extensions, and consolidation as shown in Fig. 7, has been accompanied by many efforts to reduce the cost of operation. Among other things there has been a constant effort to increase the speed of handling passengers. This is reflected both in the use of larger and heavier cars and in higher scheduled speeds, in spite of increased density of street traffic. Speed has increased greatly since the earlier days of the industry. Distances that are now traversed in from ten to twelve

[1] Report Public Service Commission, First District, New York, 1913, Vol. II, page 93.

[2] The companies analyzed by Mr. G. H. Davis for example, disclose a decrease in the average revenue per passenger, including transfer, of from 4.248 cents per passenger in 1900 to 3.866 cents per passenger in 1910, or a decrease of 9 per cent.
*See also.*— The Decreasing Financial Returns upon Urban Street Railway Properties — Dr. Thomas Conway, Jr.,— *American Academy of Political and Social Science* — January, 1911.— The Free Transfer Problem — F. W. Coburn — *Stone & Webster Public Service Journal*, February, 1909.

minutes formerly required an hour. This saving in time means saving in dollars to the street car patron. Greater speed, however, has been accompanied by the use of heavier cars with increased power consumption per car mile from 1.98 kw-hr. in 1902 to 2.94 kw-hr. in 1907 and 3.80 kw-hr. in 1912. There has been a corresponding increase in the investment in track and equipment. This is apparent upon a

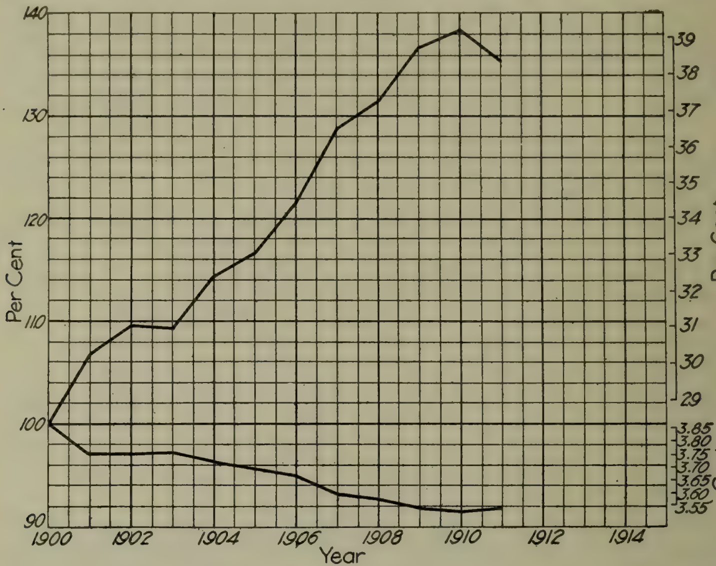



FIG. 8. EFFECT UPON RATE OF FARE OF EXTENSIONS OF TRANSFER PRIVILEGE UPON THE LINES OF 12 URBAN COMPANIES.

comparison of the 70 to 140 lb. rails of today, laid upon a concrete substructure or upon expensive, closely spaced, rock and gravel ballast, with the 30 to 40 lb. rails of early days, laid on light stringers and ties with no ballast other than the excavated dirt, and the brick and concrete structures of today with the light frame structures used in the past to house the cars and horses.

The single truck car of 1890 weighed an average of about 600 lb. per passenger seat. From 1890 to 1900 there was an increase of about 30 per cent in weight, while the double truck pay-as-you-enter car of 1912 weighs approximately 1300 lb. per passenger seat[1] — an increase of 100 per cent in 20 years. Moreover, the horse car and horses of earlier days cost about $2 500 while the modern car described above costs as high as $7 000. It is true that the increased weight of cars

[1] 1902 Bulletin of the United States Bureau of Census on Street and Electric Railway, page 195, and *Electric Railway Journal*, August 3, 1912, page 168.

is partly due to increased seating capacity. However, size and weight have, generally speaking, increased at a far greater rate than seating capacity, due to the requirements of public convenience in entering and leaving, and particularly safety in operation.

Studies of the extent to which operating costs are influenced by car weight or load weight indicate that through the elimination of weight transported either in the form of cars or of passengers, large savings in operating and other expense items could be effected. Thus, Mr. Davis estimates this saving to be from 5 to 10 cents per pound per year when based upon an assumed distance of transportation of a car for the period amounting to approximately 50 000 miles. The exact savings per pound, he states, will depend upon location, climate, grades and other road conditions, as well as efficiency of management and equipment.[1]

Together with greater speed there has developed more frequent service. Ordinance requirements as to headways originally designed for application to short lines of dense traffic are now applied to extensions into territory where the number of passengers is few.

In spite of the growing length of ride for one fare, increased transfer privileges, more expensive equipment, greater speed and more frequent service, community requirements have become more and more exacting. Taxes have increased and paving and street cleaning requirements, those anomalous heritages of horse car operation, are constantly growing more burdensome. The following comparison of the increase of electric railway and steam road taxes is of interest:

TABLE XIV — TAXES

| | Per cent gross revenue | | | Per cent gross less operating expenses | | |
|---|---|---|---|---|---|---|
| | 1912 | 1907 | 1902 | 1912 | 1907 | 1902 |
| Electric railways | 5.98 | 4.60 | 5.23 | 13.8 | 11.1 | 12.2 |
| Steam roads | 4.26 | 3.10 | 3.15 | 13.9 | 9.6 | 8.9 |

The 1912 Bulletin on Street and Electric Railways of the United States Department of Commerce, Bureau of the Census, shows that the percentage ratio of taxes to gross revenue for operating and lessor

[1] " Among the items of expenditure influenced by weight transported are maintenance of roadway, power plant, cars and equipment, operating costs, as power plant, wages, fuel, water and miscellaneous, together with interest, taxes and depreciation on the property affected. Transportation and general expense items are not included. . . . From a consideration of a large number of typical examples, it would appear that the addition or subtraction of passenger weight at the rate of $0.075 per pound, per year, may not influence the total operating and other expenditures to a greater extent than 20 per cent."
G. H. Davis, " The Adjustment of American Street Railway Rates to the Expansion of City Areas," *American Electric Railway Association*, January, 1911, page 4.

companies combined was for the year 1902, 4.8 per cent, and for 1912, 5.6 per cent, an increase of over 16 per cent in ten years.[1]

The paving requirements of today usually mean granite blocks of specified dimensions, vitrified brick or wooden blocks and in many cases necessitate the laying of concrete on top of the ballast to provide a base for the pavement.[2] There was little pavement in the early years and what there was consisted of the less expensive types. The increased number and weight of vehicles at the present time, particularly since the modern types are self-propelled and move at high rates of speed, not only necessitate the paving of streets previously unpaved but require, moreover, better and more costly construction both because of the better service demanded by high speed vehicles and because of the damaging effect of power vehicles.

Not only have community requirements imposed a heavy and steadily increasing burden upon the operating company, but the investment per mile of track has steadily increased as is shown in Table XV.

---

[1] It is important to note that the public policy of imposing these burdens has been seriously questioned. The Committee on Taxation of Public Service Corporations of the National Tax Association, has stated:

"A generation ago, before states and the nation had undertaken to regulate effectively, through commissions or otherwise, the service and charges of public service corporations, this theory (*i. e.*, special taxation much heavier than that imposed on other classes of business or property because they hold special franchises of great value) offered a natural and logical remedy for some of the evils of unregulated monopoly. Taxes upon the property of unregulated monopolies will tend, generally speaking, to fall upon the monopolists, and by their agency the government may secure a share of the profits of the monopolies. But the situation changes when public service corporations are brought under effective regulation. Under the latter condition, regulation of rates and service must proceed upon the theory that the corporations should be allowed to earn a reasonable return upon a fair valuation of their property. Special taxes upon regulated monopolies therefore, merely increase the expense of providing the service and increase the rates necessary to allow a reasonable return, or else diminish the resources available for extending and improving this service. Effective regulation completely alters the incidence of special taxes upon monopolies and at the same time removes the evils which lead to the demand for such taxation. (Proceedings of the Seventh National Conference of the National Tax Association, 1913, page 375.)

Halford Erickson, Chairman of the Wisconsin Railroad Commission, in his address, "Regulation *vs.* Profit Sharing," states:

"If the taxpayers and the users of the service were the same persons, and if there also was a close relation between the amount thus paid as taxes and the use made of the service then it would make but little difference whether the toll was levied or not. But this is not often the case. In the street railway service, for instance, the patrons or users are largely made up of wage and salary earners and this is also true in other utilities. It is, therefore exceedingly important that the service should not be burdened by unnecessary charges." (Mid-Year Conference, American Electric Railway Association, 1914; AERA, March, 1914, page 789.)

Bion J. Arnold, Chairman of the Board of Supervising Engineers, Chicago Traction, states:

"The question of taxation is being more carefully analyzed and it is recognized by some students of transportation problems, that perhaps the railroads have been called upon to carry more than their share of the tax burden. . . . This fact is becoming apparent — that there is very little surplus left for taxes particularly for the payment of a franchise tax, if a company is to furnish adequate service, properly maintain its property, provide for depreciation due to renewals and obsolescence and pay even a moderate return on investment so that needed extensions may be financed." (Report on Pittsburgh Transportation Problem, page 23.)

[2] The unfairness of the paving and cleaning burden is pointed out clearly by E. G. Connette, President of the International Railway of Buffalo, New York, as follows:

"As the necessities arose for the extension of lines and franchises were sought by companies, the public authorities have been from time to time imposing additional conditions. One that is now very burdensome arose out of the conditions existing during horse-car times because the horses, traveling between the rails, wore out the roadway. The reason for this requirement has long since passed, but the burden of the expense remains. The cost of paving the so-called 'railroad strip' is represented in the five-cent fare, while the abutting property owner receives the benefit besides an appreciation of the value of the property by reason of the street railway service. Patrons of the street railway should not be required to contribute even indirectly toward charges of this kind." (E. G. Connette, "What Can we Give for a Nickel" Paper read at the Thirty-third Annual Convention of the New York Electric Railway Association, *Electric Railway Journal*, July 3, 1915, page 18.)

TABLE XV — AVERAGE COST OF CONSTRUCTION AND EQUIPMENT PER MILE OF TRACK — UNITED STATES[1]

| Year | Cost per mile of track |
|---|---|
| 1912 | $113,579 |
| 1907 | 105,735 |
| 1902 | 96,005 |
| 1890 | 47,933 |

This increase is due among other things to the following factors:

1. Increased extent of paved streets.
2. Cost of opening streets in which are sewers, water, gas, and other mains and conduits.[2]
3. Cost of placing distribution system underground.
4. Construction necessitated by elevation and depression of steam lines.
5. Separation of grades by construction of subways and elevated lines.[3]
6. Provisions against electrolysis.

The financial and operating statistics of the conservatively and efficiently managed and capitalized Boston Elevated Railway Co., as shown in Fig. 9, are an interesting commentary on increased cost due to community requirements. This figure indicates that only a small part of the investment of later years has been productive, the major portion having been spent to adapt the system to operate in a congested city.

Extreme congestion in business and other districts has contributed to an increase in the number and cost of accidents and employers'

[1] 1912 Census.

[2] The cost of constructing footings for elevated structure and tunnels for subways, and the cost of placing the distribution system underground in city streets is indicated by the following extract from a report to the chief engineer of the Public Service Commission for the first district of New York:

" . . . With curb lines but 37 ft. apart there are 17 pipes, 8 of which are gas, 4 belonging to one company. There are four banks of electric ducts ranging from 6 to 48 holes each, and the two underground trolley tracks. The total section area of pipes only is about 25 sq. ft., including duct banks about 48 sq. ft. and including also the prisms of the two car tracks, 74 sq. ft.

At the intersecting streets, each of which brings in a considerable number of mains and duct banks, the space left for backfill will be even less. To the above areas, 17th street adds 12 sq. ft., 18th street, 21 sq. ft. and 20th street, which is about the average, 6.6 sq. ft." *Engineering News*, August 5, 1915.

[3] " Grade crossing elimination is a subject of ever-increasing importance. At the same time the whole question of a just and rational way of providing for such work and dividing the expense equitably is in a state of chaos. Except in a few Eastern states where there has been some attempt at a percentage basis, the railroads are at the mercy of the states and municipalities they traverse. The railroads patiently eliminate grade crossings as ordered, make such dickers as they can to lighten or offset the financial burden and pay the entire cost if they can do no bargaining. . . . Where there are few demands for the separation of grades the money involved is not excessive, but it may be taken for granted that these demands will constantly increase in numbers. . . ."

C. W. Stark, associate editor, *Engineering Record*, March 13, 1915.

See also: *Bulletin*, American Railway Engineering Association, November, 1914.

" Apportioning Grade Separation Costs," *Railway Age Gazette*, December 25, 1914.

" Chaos in Apportioning the Cost of Grade-Crossing Elimination," *Engineering Record*, March 13, 1915.

liability laws have likewise tended to increase the amounts expended for injuries and damages. In ten years from 1902 to 1912, the amount so expended annually in the United States has increased from nine to twenty-one million dollars.

Regulation has increased many fold the legal and clerical expenses necessitated by the defense of cases and the furnishing of regular and special reports. In the meantime the actual fare has decreased and the fare per mile of ride to a considerably greater extent is less than it was in the past. Moreover, the purchasing power of money has been constantly diminishing.

Not only have the quantity and quality of traction service increased and the fare decreased but the cost of nearly everything an electric railway has to buy has increased; that is, there has been a decrease in the purchasing power of the nickel. It is true that improvements in the efficiency of equipment have occurred for such urban systems as were in a position to take advantage of them,[1] but the benefits have been on the whole much more than counterbalanced by increased costs in other items.

The following table, based on the best data available,[2] shows very clearly the effect of increased costs and decreased revenue upon the results of the operation of electric railways during the ten years from 1902 to 1912.

TABLE XVI — OPERATING NET AFTER DEDUCTION OF TAXES IN DOLLARS PER MILE OF TRACK

| SIZE OF COMPANY | Annual revenue \$1,000,000 or over | Annual revenue \$250,000 to \$1,000,000 | Annual revenue less than \$250,000 |
|---|---|---|---|
| 1912 | \$7,245 | \$3,012 | \$1,598 |
| 1902 | 7,797 | 3,103 | 1,308 |

The effect of the decreased purchasing power of money on

1. Cost of capital invested,
2. Cost of labor, and
3. Cost of materials,

may be separately analyzed.

The steady rise in interest rates characteristic of recent years has been one of the marked evidences of the decrease in the purchasing

[1] The advantage of a possible decreased cost of generation of power, for example, must be balanced against the certain loss accruing from the scrapping of equipment not yet worn out. There must also be considered in this connection the fact that the credit of electric railways, due to the unremunerative state of the industry, has not been such during the past ten years as to permit the acquisition of new capital on favorable terms.

[2] United States Census, 1912, Central Electric Light and Power Stations, and Street and Electric Railways.

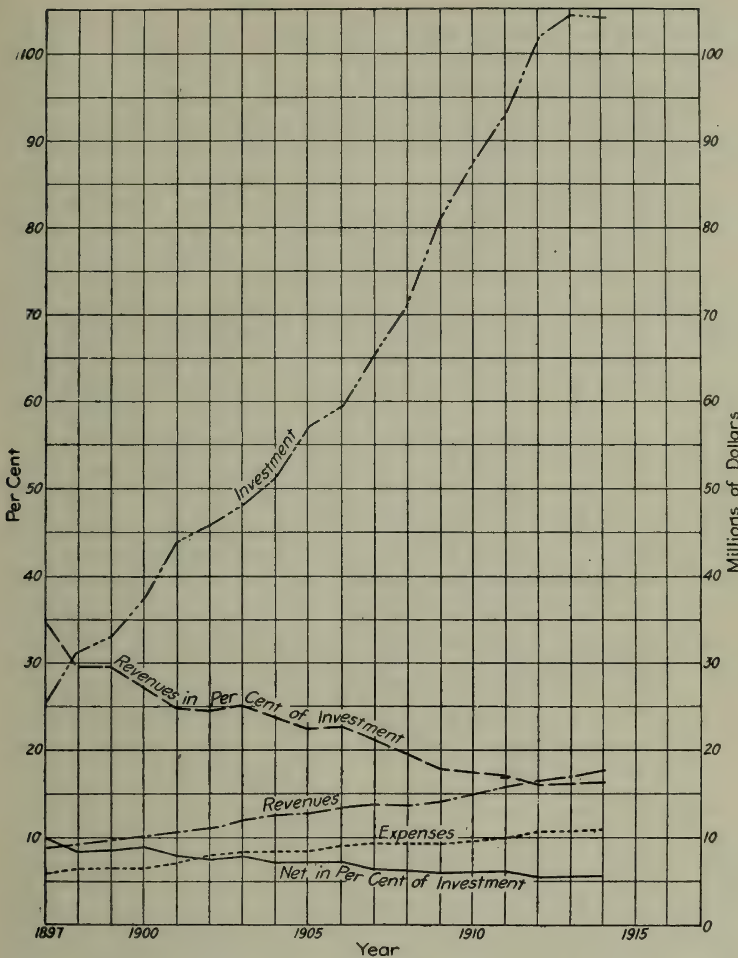



FIG. 9. INVESTMENT, REVENUES AND EXPENSES FOR 18 YEARS — BOSTON ELEVATED RAILWAY COMPANY

power of money. An analytical study of railway indebtedness, including guaranteed dividends (amounting in the aggregate to $9 499 099 065), made in 1908, by C. C. McCain, Chairman of the Trunk Line Association[1] indicates in general that the average rate of interest demanded by those who supply railway capital has greatly

[1] C. C. McCain, "The Diminishing Purchasing Power of Railway Earnings," *Railway Library*, 1909, page 176.

increased.[1] Table XVII reproduced from Mr. McCain's article, is of interest in this connection:

TABLE XVII — RATE OF INTEREST AND PROPORTION OF TOTAL INDEBTEDNESS INCURRED DURING YEAR AND OUTSTANDING

| Year | Borrowed | Per cent. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 6½ | 6 | 5 | 4½ | 4 | 3¾ | 3½ | 3 |
| 1897 | $100 | .... | 2.24 | 8.54 | 1.56 | 41.73 | .... | 44.92 | 1.01 |
| 1898 | 100 | .... | 0.12 | 1.92 | 0.05 | 48.08 | .... | 49.83 | ..... |
| 1899 | 100 | .... | 2.59 | 5.77 | 3.14 | 54.91 | .... | 25.05 | 8.54 |
| 1900 | 100 | .... | 0.53 | 7.40 | 3.71 | 38.94 | .... | 29.10 | 20.32 |
| 1901 | 100 | .... | 0.35 | 7.58 | 7.38 | 74.55 | 0.07 | 10.07 | ..... |
| 1902 | 100 | .... | .... | 9.53 | 4.23 | 73.80 | .... | 12.44 | ..... |
| 1903 | 100 | .... | 0.36 | 12.54 | 5.17 | 74.40 | .... | 5.22 | 2.31 |
| 1904 | 100 | .... | 0.08 | 18.82 | 9.30 | 59.53 | .... | 12.27 | ..... |
| 1905 | 100 | .... | 0.28 | 10.44 | 11.65 | 57.38 | .... | 17.73 | 2.52 |
| 1906 | 100 | 0.07 | 0.23 | 27.55 | 7.95 | 48.78 | 9.38 | 6.04 | ..... |
| 1907 | 100 | .... | 4.28 | 40.86 | 29.10 | 29.70 | .... | 0.06 | ..... |
| 1908 [2] | 100 | .... | 43.00 | 17.86 | 1.07 | 38.07 | .... | .... | ..... |
| Average | $100 | 0.01 | 3.25 | 15.34 | 8.00 | 53.49 | 0.89 | 16.87 | 2.15 |

In further substantiation of the rise in interest rates, the following table, reproduced from testimony,[3] in the Western Advanced Rate Case, is also of interest:

TABLE XVIII — PURE MONEY RATE[4]

| Year | Per cent | Year | Per cent |
|---|---|---|---|
| 1900 | 3.02 | 1908 | 3.47 |
| 1901 | 3.01 | 1909 | 3.41 |
| 1902 | 3.05 | 1910 | 3.54 |
| 1903 | 3.08 | 1911 | 3.55 |
| 1904 | 3.17 | 1912 | 3.59 |
| 1905 | 3.11 | 1913 | 3.82 |
| 1906 | 3.22 | 1914 | 3.77 |
| 1907 | 3.42 | ........ | ......... |

[1] C. C. McCain, "The Diminishing Purchasing Power of Railway Earnings," *Railway Library*, 1909, page 177: "In 1897 and 1898, the largest aggregate of new indebtedness was incurred (at the rate of 3½ per cent per annum); from 1899 to 1907, the prepondering portion was at 4 per cent; in 1907, the largest aggregate was at 5 per cent, while in the months of 1908, for which data are available, the greater portion was obtained at 6 per cent."

[2] January to July only.

[3] Interstate Commerce Commission, I. and S. docket 555, Western Advance Rate Case, Brief on behalf of State Railroad Commissions, page 158.

[4] "The best Government bonds of the four principal nations, England, France, Germany and the United States, and municipal bonds of the twenty largest cities of the United States. Both of these classes reflect or limit the zone of the pure money rate . . . Government bonds would probably be slightly below pure money earnings; municipals would be a little above. These securities are those where the personal factors of hazard and risk are the most completely eliminated." (Interstate Commerce Commission, I. and S. docket 555, Western Advance Rate Case, tr. 13678–13679.)

Under present conditions of regulation, public utility securities, including urban street railways, may be considered in general a safe investment. However, due to a number of factors, one of which is habit, it has been often found difficult to float them because of the youth of the public utility business.[1]

The importance of this rise in the cost of capital can be fully appreciated when there are taken into consideration the great sums of new capital required annually for the necessary extensions and improvements of street railways. While some of the instances cited deal largely with the increased cost to steam railroads, it must not be forgotten that private capital is free to seek improvement where the greatest returns are offered,[2] and that the urban utility is in competition in the money market with other industries. It is pertinent to note that the attacks upon public utilities have appreciably raised the interest rates through making investments therein unattractive to the investor.

It is a generally admitted fact that there has been since 1897, a gradual but constant increase in the prices of both raw materials and manufactured commodities. Numerous investigations within the last few years, made through private and governmental agencies, have led to the formulation of various theories as to the cause of this increase in the cost of living. Whatever the reasons for the increased cost may be, it is evident that the electric railway has been particularly affected by these changes in conditions.

---

[1] In this connection, the following table prepared by W. H. Gardiner, formerly statistician, Henry L. Doherty & Co., is of interest:

| CLASS OF SECURITIES | Market price | Net earnings | Risk of receivership |
|---|---|---|---|
| | | *(Per cent)* | *(Per cent)* |
| Steam railroads | 120 | 4.25 | 1.84 |
| Industrials | 94 | 7.79 | 2.07 |
| Public utilities | 90 | 8.45 | 0.37 |

"If we standardize the railroads (as they are considered standard securities) at 100, then, proportionately public utilities are selling at 75 (90:120), even though they are five times as safe (0.37:1.84), and have earned nearly twice as much (8.45:4.25)."

W. H. Gardiner, *Electric Railway Journal*, June 6, 1914, page 1279.

[2] Ibid.

"Public demands for more and more service have forced the public service business to more than double its magnitude in the last decade. The present prospects are that during the next few years about $1,200,000,000 per annum of new capital money must be put into the business in the United States — in other terms, $4,000,000 of new money for each working day.

"Failure to get most of this vast amount of new money would have collateral effects somewhat detrimental to present investments in the business. But should this new capital not come into the business, the service rendered the public would suffer to a vastly greater extent, as it would be impossible to meet the public requirements for additional service. What would be the public loss if during the next decade none of the new houses, hotels or theatres could be supplied with electric light or if no new railway tracks or cars could be put in operation in our cities and their upbuilding suburbs?

"The paramount problem of the public utility business is not that the earnings of its present capital be made as light a burden as possible but that conditions be made such that adequate new capital will seek investment in the business."

Urban street railways are employers of labor of many kinds. In addition to the platform labor, or motormen and conductors, it must employ a variety of other kinds, ranging from the most skilled trades to the least skilled common labor. Moreover, its annual expenditures for labor in salaries and wages amount to approximately 60 per cent of its operating expenses.

As a result of the constantly rising cost of living, there has been a general rising-wage movement in the United States as is shown in Fig. 10.[1] Since the electric railways of the country must compete in

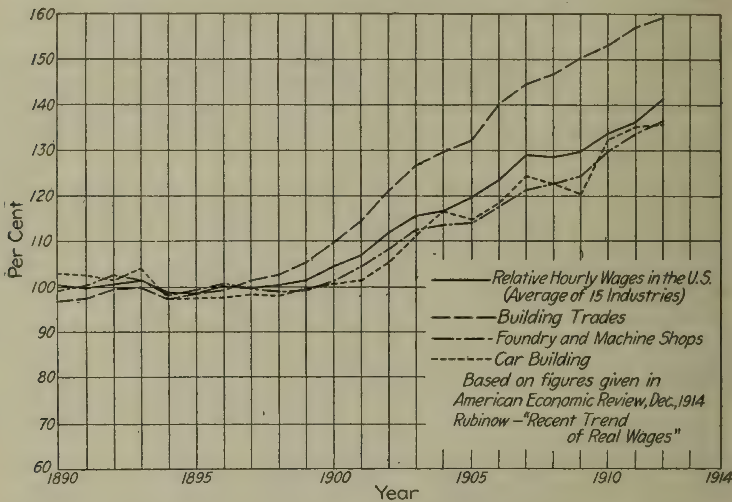



FIG. 10

the labor market with other industries they have met, insofar as they were able, this rising wage scale to avoid the loss of their best men, who would otherwise have been attracted to other and more remunerative industries. Fully one third of the electric railway wage expenditure is for skilled labor, such as machinists, painters, carpenters, bricklayers, etc. The rise in wages in these trades is particularly noticeable and is shown in Fig. 11. Detailed statistics of wages paid to platform labor have not been collected from year to year and no adequate comparison can therefore be made. Such comparisons as have been made, however, of the figures in the Bureau of the Census bulletins indicate that index numbers of platform wages, which comprise about 30 per cent of the total labor expenditure, have followed closely the rise in the cost of living.

[1] The sources of statistics upon which the following figures are based are discussed in the following pages.

Table XIX, based upon the bulletin of the United States Bureau of the Census, shows in greater detail the actual increase in the annual wages paid to the various classes of labor. It may be of interest to note in this connection that the per cent increase in the annual salaries and wages paid to all classes of labor has been smallest where such salaries and wages were originally highest.

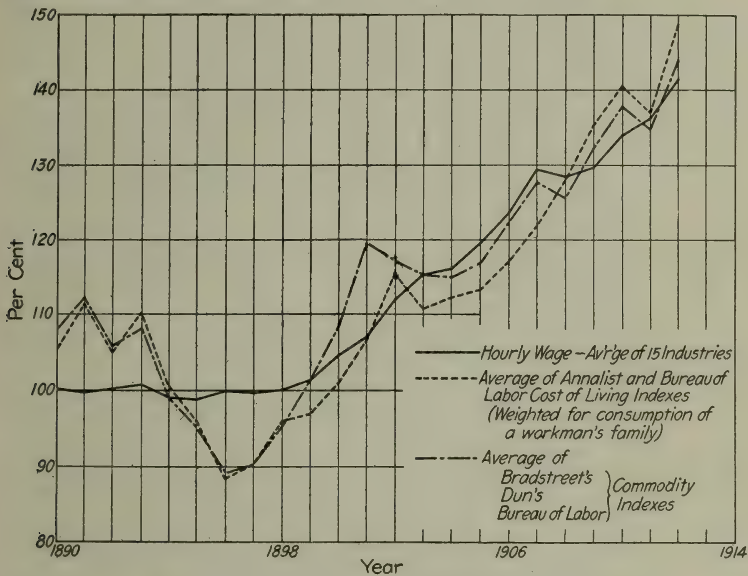



FIG. 11

In order that as reliable information as possible be obtained upon the increase in costs, numerous statistical sources have been consulted and the results, wherever comparable, have been averaged and reduced to index numbers. It should be borne in mind that although all the series of index numbers used have a marked resemblance in that they indicate, for example, that prices fell considerably during the period from 1890 to 1896, and that prices have steadily risen since that time, yet, strictly speaking, the various series are comparable only after being subjected to a thorough analysis and reduced to a common basis. It is not, however, necessary to make such refinements in order to observe the very obvious tendencies of costs during recent years.[1]

[1] Of great interest in this connection is Bulletin No. 173 of the United States Bureau of Labor Statistics (1915), prepared by W. C. Mitchell, and but recently distributed. The bulletin is devoted to a thorough study of index numbers of wholesale prices in the United States and foreign countries. It contains an analytical study of the making and using of index numbers, a study of the index numbers of wholesale prices in the United States and foreign countries and a selected bibliography of additional index numbers. This bulletin is recommended to those desiring to pursue further investigations along this line.

TABLE XIX — ANNUAL SALARIES AND WAGES[1]

| Geographical Districts | Salaries per Year | | | Wages per Year | | | Platform Wages Only | | | Mean Salary or Wage All Labor | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Amount | | 1912 in per cent of 1902 | Amount | | 1912 in per cent of 1902 | Amount | | 1912 in per cent of 1902 | Amount | | 1912 in per cent of 1902 |
| | 1912 | 1902 | | 1912 | 1902 | | 1912 | 1902 | | 1912 | 1902 | |
| United States | $1,120 | $1,040 | 107.6 | $675 | $605 | 111.5 | $725 | $606 | 119.5 | $711 | $627 | 113.2 |
| New England | 1,170 | 1,030 | 113.5 | 650 | 630 | 103.0 | 649 | 647 | 100.2 | 698 | 654 | 106.8 |
| Middle Atlantic | 1,171 | 961 | 121.9 | 671 | 596 | 112.5 | 733 | 595 | 123.0 | 708 | 611 | 115.7 |
| East North Central | 1,067 | 1,058 | 101.0 | 682 | 615 | 110.9 | 773 | 644 | 120.0 | 714 | 640 | 111.3 |
| West North Central | 1,160 | 1,184 | 98.0 | 730 | 633 | 115.2 | 727 | 609 | 119.1 | 764 | 662 | 115.1 |
| South Atlantic | 1,034 | 972 | 106.4 | 577 | 481 | 120.0 | 619 | 468 | 132.2 | 626 | 511 | 122.5 |
| East South Central | 1,222 | 1,189 | 103.0 | 567 | 505 | 112.2 | 600 | 464 | 129.0 | 621 | 526 | 118.0 |
| West South Central | 1,113 | 1,308 | 85.3 | 635 | 606 | 104.7 | 679 | 603 | 112.5 | 681 | 642 | 106.1 |
| Mountain | 1,243 | 1,238 | 100.5 | 845 | 764 | 110.5 | 881 | 777 | 113.5 | 889 | 795 | 111.8 |
| Pacific | 1,084 | 1,222 | 88.5 | 757 | 705 | 107.5 | 825 | 656 | 126.0 | 797 | 731 | 109.0 |

[1] Based on U. S. Bureau of the Census figures.

The following brief discussion indicates the methods used in the present case. The cost-of-living figures were made up somewhat as follows. There were obtained from Bulletin No. 140 of the United States Bureau of Labor Statistics, the relative retail prices of fifteen articles of food weighted according to their average consumption in workingmen's families throughout the United States. These figures were then averaged with the cost-of-living index numbers prepared from time to time by the *New York Times Annalist,* and which are based on a hypothetical average family budget. The relative prices of commodities in general were obtained by averaging Bradstreet's "Index Number of Staple Articles," made up by taking the average during each month of 96 staple articles whose fluctuations in price have been found to follow fairly closely commercial conditions; Dun's "Index" obtained by multiplying the price of each unit of a wide variety of commodities by the number of such units consumed in the United States; and the United States Bureau of Labor, Bulletin No. 149, giving the average prices at wholesale of more than 250 commodities for each year since 1890. The general wage statistics were obtained from the United States Bureau of Labor, Bulletin No. 77, and partly from the *American Economic Review* for December, 1914.[1] The electric railway wage statistics were taken from the bulletins of the United States Bureau of the Census.

The conclusion is overwhelmingly confirmed by these figures, that compared with the decrease in rate of fare, there has been a substantial increase in labor cost and this increase has been occasioned not by extravagance and inefficiency, but by the tendency of wages to increase with the cost of living. The purchasing power of the single fare, in fact, or its real value, has depreciated at a far greater rate than its nominal value, as expressed in cents per passenger carried. These facts have been brought out in great detail in a number of cases, having been cited as arguments both for increased wages and for increased freight and passenger rates. Generally speaking, it has appeared that the increase in wages has been fully commensurate with the increased costs of living, but that the price of transportation has fallen both absolutely and relatively as compared with other prices.[2]

The fact that there has been a general advance in the prices of raw and manufactured commodities has been already commented upon. Since materials constitute about 30 per cent of the annual operating expenses of street railways and about 50 per cent of the amounts annually invested in replacements, improvements and extensions, the significance of the increases is easily apparent.

---

[1] "Recent Trend of Real Wages," Rubinow, *American Economic Review*, December, 1914.

[2] For an interesting presentation of this matter, see *Electric Railway Journal*, Vols. XLIV and XLV — The Bay State Street Railway Arbitration.

The increases in average relative prices of commodities in general have already been pointed out, but since some of the commodities included in these comparisons are more widely used by electric railways than others, the following table has been compiled to show the relative wholesale prices of such groups of commodities. While the amount expended for each commodity varies from time to time and as between different companies, the data substantiate the general conclusion already reached with respect to cost of money and cost of labor, that the street railway's cost of living has materially increased during the past decade.

TABLE XX — RELATIVE PRICES OF MATERIALS USED BY ELECTRIC RAILWAYS IN THE UNITED STATES[1]

(Average for 1890–1899 = 100 per cent) Averages of Groups of Materials

| | Paint materials | Lumber | Coal | Implements and tools | Building materials | Metal group |
|---|---|---|---|---|---|---|
| 1895 | 94.7 | 98.7 | 90.3 | 93.0 | 90.6 | 96.5 |
| 1896 | 88.1 | 99.4 | 90.2 | 95.1 | 89.6 | 94.7 |
| 1897 | 87.7 | 99.0 | 91.2 | 87.4 | 94.0 | 88.5 |
| 1898 | 93.6 | 98.2 | 95.3 | 88.5 | 103.9 | 84.7 |
| 1899 | 109.1 | 105.7 | 98.8 | 103.9 | 106.6 | 128.9 |
| 1900 | 124.5 | 111.0 | 126.0 | 115.7 | 102.5 | 129.9 |
| 1901 | 111.1 | 103.1 | 133.8 | 108.3 | 120.8 | 125.6 |
| 1902 | 119.5 | 111.5 | 180.8 | 112.8 | 110.2 | 117.3 |
| 1903 | 114.9 | 126.2 | 206.8 | 112.3 | 106.3 | 114.9 |
| 1904 | 110.6 | 130.5 | 164.7 | 110.8 | 110.3 | 101.2 |
| 1905 | 117.2 | 130.4 | 152.2 | 116.5 | 113.2 | 110.9 |
| 1906 | 122.0 | 133.1 | 148.6 | 120.9 | 120.5 | 121.3 |
| 1907 | 123.3 | 139.4 | 150.6 | 125.5 | 109.4 | 131.2 |
| 1908 | 109.8 | 133.4 | 147.3 | 118.3 | 100.0 | 111.3 |
| 1909 | 118.1 | 134.5 | 140.5 | 115.0 | 104.7 | 104.6 |
| 1910 | 143.6 | 142.8 | 141.9 | 118.7 | 109.2 | 107.0 |
| 1911 | 145.2 | 146.0 | 145.6 | 108.9 | 104.2 | 99.9 |
| 1912 | 121.8 | 149.6 | 144.8 | 111.2 | 105.4 | 104.5 |
| 1913 | 110.9 | 157.0 | 149.9 | 116.4 | 113.2 | 110.4 |

It is not possible to ascertain the amount expended by electric railways for the several items listed in Table XX. However, the expenditure for coal which is chiefly used as fuel for power can be determined with some accuracy. In 1912, according to the United States Bureau of the Census, the electric railways of the country expended over $20 000 000 for coal. If the same amount of coal could have been bought at prices prevailing in 1895, a saving of $7 500 000 could have been effected, or fifteen per cent of the total dividends paid in 1912.

[1] Partly based on the United States Bureau of Labor Bulletin No. 149; partly on other publications, such as the *Iron Age*, etc.

The items shown in the following table have been taken from Bulletin No. 149 of the U. S. Bureau of Labor Statistics and confirm in particulars the general conclusions drawn from the preceding table.

TABLE XXI — COST OF RAILWAY SUPPLIES — WHOLESALE PRICES

(Bulletin No. 149, United States Bureau of Labor Statistics)

| ARTICLE | Unit | Price in dollars | | |
|---|---|---|---|---|
| | | Average, 1890–1899 | 1913 | Increase, per cent |
| Axes, M. C. O. Yankee | each | $0.4693 | $0.7000 | 49.1 |
| Bar iron, best refined, from mill | lb. | 0.0145 | [1] 0.0187 | 29.0 |
| Brick, common, domestic | M | 5.5625 | 6.5625 | 18.0 |
| Cement, Portland, domestic | bbl | 1.9963 | 1.5800 | [1] 20.8 |
| Coke, Connellsville furnace | ton | 1.6983 | 2.4396 | 43.6 |
| Copper wire, base | lb. | 0.1464 | 0.1673 | 14.3 |
| Doorknobs, steel, bronze plated | pair | 0.1697 | 0.2700 | 59.0 |
| Doors, pine | each | 1.0929 | [3] 1.6900 | [3] 54.7 |
| Files, 8 inch | doz | 0.8527 | 0.9203 | 7.9 |
| Hammers, Maydole, No. 1½ | each | 0.3613 | 0.4400 | 21.8 |
| Lead pipe | cwt | 4.8183 | 5.0817 | 5.6 |
| Lime, common | bbl | 0.8332 | 1.0783 | 29.5 |
| Linseed oil, raw | gal | 0.4535 | 0.4621 | 1.9 |
| Locks, common, mortise | each | 0.0817 | 0.1200 | 47.0 |
| Lumber, hemlock | M ft | 11.9625 | 24.2273 | 102.5 |
| Lumber, maple, hard | M ft | 26.5042 | 38.3636 | 44.6 |
| Lumber, oak, white, plain | M ft | 37.4292 | 60.5909 | 61.7 |
| Lumber, oak, white, quartered | M ft | 53.6771 | 88.3182 | 64.4 |
| Lumber, pine, yellow | M ft | 18.4646 | 32.1364 | 74.0 |
| Lumber, poplar | M ft | 31.3667 | 61.7273 | 96.7 |
| Lumber, spruce | M ft | 14.3489 | 27.8636 | 94.1 |
| Nails, cut, 8-penny-fence and common | cwt | 1.8275 | 1.7708 | [2] 3.0 |
| Nails, wire, 8-penny-fence and common | cwt | 2.1618 | 1.8188 | [2] 15.9 |
| Pig-iron, Bessemer | ton | 13.7783 | 17.1325 | 24.3 |
| Pig-iron, foundry No. 1 | ton | 14.8042 | 17.0675 | 15.1 |
| Pig-iron, foundry No. 2 | ton | 13.0533 | 10.6083 | 22.6 |
| Pig-iron, gray, forge, Southern, coke | ton | 11.0892 | 14.0979 | 27.1 |
| Shingles, cypress | M | 2.8213 | 3.5417 | 25.6 |
| Steel, billets | ton | 21.5262 | 25.7892 | 19.5 |
| Steel, rails | ton | 26.0654 | 28.0000 | 7.5 |
| Steel, sheet, black, No. 27 | lb. | 0.0224 | 0.0219 | [2] 2.2 |
| Tin, pig | lb. | 0.1836 | 0.4488 | 144.7 |
| Tin, plates, domestic, Bessemer, coke | cwt | 3.4148 | 3.5583 | 4.2 |
| Window glass, American | 50 sq. ft. | 2.1514 | 2.7200 | 27.5 |
| Window glass, American | 50 sq. ft. | 1.8190 | 2.2207 | 22.0 |
| Zinc, sheet | cwt | 5.3112 | 7.2450 | 36.5 |

[1] 1905. [2] Decrease [3] 1904.

As has been previously pointed out, changed standards of construction and maintenance have accompanied these increases in the cost of materials. The price per ton of steel rails has not varied greatly in recent years; yet the increased weight of rails used in modern construction has in many cases more than doubled the cost

per mile of track. Higher speeds and heavier cars, moreover, have made it necessary to expend large sums for special steels used in crossings and turnouts, and the number and complexity of such installations greatly exceed the requirements of earlier days due to the consolidation of lines and the consequent provision for through routing of equipment.

### Conclusions

The following general conclusions may be drawn:

(1) Comparing conditions obtaining at the beginning of the electric traction industry, being the period 1890 to 1895 for most urban traction systems, and present conditions, it is noted that there has been a substantial increase in service rendered. The length of ride for a single fare has increased with the growth of cities and the unification of separate traction systems operating in the same community. The quality of the service as measured in speed, more frequent operation, and more substantial, convenient and safe equipment, has materially improved.

(2) During the same period the single fare has suffered material reduction due to increased use of transfers and commutation tickets. The increased length of haul per passenger has materially decreased the revenues received per passenger mile.

(3) During the same period, construction costs and operating expenses and taxes have been materially increased, due to the increased complexities of urban life and the substantial character of municipal requirements.

(4) During the same period there has been a substantial increase in the cost at which investors can be induced to furnish money for the development of the industry, due to the general rise of interest rates and the competition of other forms of investment. Agitation against the industry and public restrictions have served to weaken the competitive position of street railway investments.

(5) Labor costs have materially increased, accompanying the advance in the cost of living. The real value or purchasing power of the five-cent fare has materially decreased.

(6) Costs of material entering into operation and construction have likewise increased. This increase accompanied by the necessity for the use of more and better material, has had an important part in increasing the cost of service.

# CHAPTER V

## UTILITY CAPITAL AND ITS REPLACEMENT

Relation of Utility Capital to Cost of Service,—— Purposes of Valuation of Street Railway Property,—— Sale, Taxation, Condemnation, Basis of Reasonableness of Public Requirements,—— Theories: Market Value, Sacrifice, and Equivalent Agency,—— Methods: Security Values, Book Values, Reproduction Estimates, Appreciation and Depreciation, Going Value,—— Replacement of Utility Capital: Necessity of Provisions for Insuring Replacement, Inadequacy of Statistical Data, Theories of Measurement of Replacement Insurance Reserves.

The current receipts and expenditures of a public utility may be readily determined from its books of account and few questions of fact arise as to the nature and amount of such recorded costs. The total cost of service, however, does not consist of operating expenses alone but must include as well the annual cost of providing the capital of the utility. Since the amount of utility capital lessens with use or is consumed in service, total cost must include provision for its replacement. In addition to preserving the integrity of the capital account it is necessary to provide returns to investors who have been induced to devote their savings to the utility business rather than to other productive enterprises. The extent of the annual provision necessary for capital replacement, and the rate of return on capital are not as readily determined as are current operating revenues and ordinary operating expenses, particularly where the investment figures on books of account fall short of, or exceed, the real value upon which these costs, replacement and return, are properly computed.

The problem has been further complicated by legal questions as to the equitable value to be considered in computations of cost where the public has an interest. There has been during the last ten years a considerable growth in the regulation of public utilities. While the extent and method of regulation have varied widely under the different statutes, from attempts to specify rates by legislative action to attempts to control the most intimate details of operation by administrative boards, the limitation has been generally imposed by the courts that the property must be protected against confiscation. Throughout regulatory legislation, therefore, we find provisions that the integrity of the investment must be maintained and that there must be allowed "fair" return on "fair" value of the property used for public service.

### Valuation of Utility Capital

Valuations of the utility capital of street railway properties have been made for various purposes. Most frequently in the past the

purpose has been to establish a value as a basis for the sale of the property and its transfer from one owner to another. Sale value has been determined by considerations of the permanency of the plant, its adaptability to the use for which purchased, and its present or future earning power. Where street railways are taxed upon an *ad valorem* basis, valuations have been made for the purpose of equalizing the tax burden with that of other taxable property such as real estate and improvements, personal property, etc. Tax values have involved estimates of cost to reproduce the property, valuations of securities outstanding at market prices, capitalization of earnings and in some cases considerations of convenience of assessment and collection and the corporation's ability to pay. Valuations have been made for purposes of condemnation also, and have involved considerations of damages as well as the various elements of sale value. The valuations which have been made for the purpose of determining the reasonableness of public requirements as to rates and service, and requiring determinations of a "fair" or "equitable" value, have involved numerous factors which it is necessary in any adequate study of costs to examine in detail.

While there has been developed abundant theory on the difference in economic bases underlying these different types of valuation, no distinctive methods have been developed which have been accorded universal acceptance. This is particularly true in the determination of "fair" values for purposes of the regulation of rates. From a review of many such cases the only safe conclusion which may be reached is that every factor or process of valuation has been of importance, although considered as persuasive in one case and controlling in another. Various legal, engineering and economic treatises have been written on the subject of valuation which enumerate these various precedents.[1] It is, therefore, not necessary to burden this discussion with such references and illustrations. It is well to have in mind, however, the conflicting theories upon which the determinations of "fair" value appear to be based, and to discuss the possible effect of their application on costs of street railway service.

### MARKET VALUE THEORY

The "Market Value Theory" seems to be the most usually accepted of the several theories of value and conforms to the "exchange value" of the economist. Value may be defined as the price at which an article is sold by one individual to another when the purchaser is a willing purchaser and the seller is not coerced, and when both are equally qualified to make the bargain. Since in the case of public utilities, the properties are so large as not to be regularly and freely bought and sold, and are so constituted as to make competition contrary to public policy, and are so controlled as not to have an earning power comparable with that of private or competitive industries, it

---

[1] A selected bibliography is given at the end of this chapter.

is necessary to determine a hypothetical market value which will approximate the price under ordinary conditions of sale.

It must be assumed that in the regular sale of public utilities the purchaser will pay for the property at least what it would cost if purchased piecemeal plus an addition because of its adaptability, because of the extent of the business done, and because of its future possibilities. It must be assumed further that like any competitive enterprise the purchaser will not pay for past mistakes but will pay for appreciation in value over cost where such appreciation exists. Finally it must be assumed that like any competitive business the earnings arise from reasonable charges and that no added value will arise because of the possibility of making future charges exorbitant.

### THE SACRIFICE THEORY

The "Sacrifice Theory" assumes that the value of a utility upon which its owners are entitled to a return is measured by the original and subsequent investment,[1] adding any losses that may have occurred and deducting any earnings in excess of what for the time and place was a reasonable rate. The theory assumes that, ordinary business prudence having been exercised throughout the history of the utility, and the investment having been made in good faith, the investor is entitled to a return upon his contribution irrespective of what may now be the market value. The amount sacrificed may be determined in much the same manner as a bank computes interest on a note. If, in any year, there is failure to pay part or all of this interest, the difference between what was due and what was paid is added to the amount of the note; and on the other hand, if in certain years the bank is paid a sum greater than the interest due for that year, the amount of the note is reduced by the extent to which the payment exceeds the amount due. This is the extreme form of the sacrifice theory. There has usually been some question as to whether the limitation of profits can be made retroactive and as to whether investment which is no longer productive should be included. With these modifications the sacrifice theory is often termed the "investment" theory. However designated, the theory assumes to calculate the basis of rates by taking, at any time, an algebraic sum of the economic benefits received and those foregone since the inception of the utility.

### THE EQUIVALENT AGENCY THEORY

The "Equivalent Agency Theory" assumes that when the community undertakes to control the operation of the utilities which serve it, the value of each utility as a basis for rates is to be determined on

[1] In determinations of value, the unit of measurement is the dollar. That this is not an invariable unit is obvious from a consideration of fluctuations in the purchasing power of money. The question may well be raised as to whether the investor of 1895 is entitled to have his equity measured to-day in terms of the dollar of 1895 or the dollar of 1915.

the theory of hypothetical and continuous competition. According to this line of reasoning, the price to be paid for service should be determined by what it would cost to render the same service by the least expensive agency which might be constructed or acquired at that time. It has, therefore, been suggested that the value of a utility is measured by the assumed cost or investment in some other utility which might render the same service. This theory has been variously modified in practical application. It is generally stated not as the cost to produce an equivalent agency, but as the cost to reproduce the same agency under current conditions.

The decisions on value in rate cases usually do not consistently follow any one of these theories to the exclusion of others because the logical process of thought often results in absurd inequalities which naturally condemn it as a judicial process, and, what is more important, because the methods used in the actual measurement of value are limited by the facts available in evidence. These facts may be enumerated as follows:

(*a*) The amount of bonds or capital stocks issued under the authority of the state or regulating commission and outstanding in the hands of investors, and their market value.

(*b*) The cost of tangible and intangible property as determined from the books of account.

(*c*) An appraisal of the cost to reproduce the physical property.

(*d*) The estimated amount of working capital required in the business, additive to any of the above determinations.

(*e*) The estimate of the extent of the failure of the utility to earn a reasonable return on its investment in the past as a measure of the cost of building up the business, additive to the above determinations.

(*f*) The estimated cost to reproduce the business of the utility under present conditions or in other words an appraisal of the going concern value of the utility, additive to the above.

(*g*) The estimated value of other intangibles, additive to the above.

Item (*a*), together with items (*c*), (*d*), (*f*) and (*g*) would ordinarily constitute the basis of a determination of value following the market value theory. Items (*b*), (*d*) and (*e*) would ordinarily measure the value following the sacrifice theory while items (*c*), (*d*) and (*f*) may measure the value upon the basis of the equivalent agency theory. The appraisal of the physical property, however, item (*c*), may be based upon present day prices or may be based on conditions obtaining in the past, and in the absence of other records may be determined as the probable sacrifice or investment. Frequently the decisions appear to add the estimate of going value obtained by measuring past losses, item (*e*), to the appraisal of the physical property, item (*c*).

The question of the treatment of appreciation and depreciation is one which has occupied a great deal of attention in connection with the determination of value. Upon the market value theory appreciation and depreciation are both considered. If real estate or other items of property have appreciated over the original cost the added value is part of the sale price. If the property has not been well maintained its market value is impaired. On the sacrifice theory it is evident that if depreciation has accrued and it has not been possible to set up a reserve out of earnings to meet it, these deficits will increase rather than reduce the "fair" value. On the other hand if returns have been sufficient and no provision for replacement has been made but the amounts have been withdrawn from the property, "fair" value is correspondingly reduced. In the equivalent agency theory appreciation and depreciation have, of course, no place since what has occurred in the past is immaterial and the cost of acquiring or constructing the cheapest plant to render equivalent service is the measure of the value to be placed on the existing plant.

Frequently in estimates of cost reference is made to the physical property only. It is obvious however that the intangible values or costs, whatever theory may be followed, are also of importance. Aside from working capital the going cost or value must be considered in both the provisions for depreciation and calculation of reasonable return.

There will be observed a considerable variation in the methods by which valuation would be carried on under these theories, although the effects on cost of service of the results of the several methods, experience shows, are not as different as might be expected. It is evident that, for example, if there is wide discrepancy between the values arrived at under the equivalent agency theory and the actual investment, correspondingly large allowances must be made for the amortization of the difference, in the cost of service. It is apparent also that if the investment no longer useful is deducted, corresponding additions must be made to the cost of service because of the necessity of replacement. Thus reconciled, the total of replacement allowance and rate of return does not vary greatly under the several theories.

Because of different conditions it is clear that substantial justice can not be done in all cases by the application of any single method of valuation. Certain cities, for example, give promise of growth and for a time increase in trade and population. With ordinary business prudence investment is made in utilities which it is expected will be operated at a low return for some years but will eventually recoup their owners for early losses. But early expectations are not always realized and the population may decline. The situation which confronts the operator and the regulating body under such circumstances is hardly to be met by the same formula as will work justice between the utility and its patrons in a city where traffic characteristics are favorable and where operations have been uniformly profitable from the beginning.

## Replacement of Utility Capital

As has been the case with the subject of valuation, much has been written upon the theories underlying the replacement of capital and it is only necessary to consider briefly the factors which must be given consideration in determining the amounts to be included in cost of service.

The rendering of continuous and adequate service is possible only when the plant of the utility is maintained in a condition of efficiency. Since, also, the physical plant represents the investment contributed as utility capital upon which security loans are made, it cannot be permitted to waste away. Courts and commissions have held with almost complete unanimity that the charge for service must be such that there will be over and above other operating expenses, fixed charges and return on investment, a sum that will permit the parts of the physical plant to be renewed from time to time as they are no longer fit for service. This is a matter of justice between owner and patron, as is the protection of his security a matter of justice between the creditor and the company.

The problem presented is then, that of insuring the replacement of property the useful life of which is such as to make advisable the spreading of the charges over a number of years. In accounting practice it is, of course, possible to replace such units as the necessity arises and to set up a suspense account to be amortized during a definite period thereafter.[1] This practice has not enjoyed the sanction of regulating bodies and careful operators and it is now generally considered that the accounting problem is that of accumulating during the life of each unit of property a fund sufficient to replace it when renewal becomes necessary.

In cost analyses it is generally considered advisable, inasmuch as the costs of replacing utility capital are likely to show a wide variation from year to year, to spread such costs as uniformly as possible over a series of years. Where the replacement is anticipated, the amount set aside annually is in fact analogous to an insurance premium. Where investment made in the past is not represented by property

---

[1] Robert Sealy, "The Accounting Treatment of Depreciation," 1914 Proceedings of *American Electric Railway Association,* states:

* * * Three courses are open:

(*a*) Replacement may be charged to current year's income when incurred.

(*b*) Replacement may be held in suspense, appearing as an open account on the asset side of the balance sheet, and amortized by charges to income for succeeding years.

(*c*) Liability for replacement may be gradually accrued by reservations from income during prior years and replacement charged against such accrual when incurred. Such a liability may be accrued as a separate reserve or held as undistributed surplus without being allocated to a separate reserve.

The first plan is open to Traction Companies of large annual income, since the replacement during any year may be of sufficient magnitude to claim a large part of operating revenues. The second plan has the objection of charging income with a part of the cost of service of prior years. It postpones the payment of an accrued liability until after the liabiility has become due. The third plan is the only one of the methods which anticipates the replacement obligation and is that generally adopted.

useful in the business during the year in question, there must be, in addition, a proportionate amount added to the cost to care for its amortization. The first provision, or that for replacement insurance, is necessitated by the operation of a variety of factors,[1] the nature and extent of which account largely for the variations in statistical data as to the life of physical property.

Such statistics of the actual life of physical property as have been gathered indicate not only that the anticipated period during which the unit of equipment will remain in service may be expected to vary over a wide range, as compared with the experience of variously situated traction properties, but varies also with the experience of a single property. This diversity of experience is evident from the studies of the life of physical property which have been made by the American Electric Railway Association and similar associations abroad.[2] There have appeared in various text books from time to time, tables of hypothetical lives of physical property, the accuracy of which in the light of these investigations may be seriously questioned. Such estimates as have been made for a traction property, as a whole, indicate that the allowance for depreciation will aggregate between four and five per cent of the cost of physical property, or between 16 and 20 per cent of the operating revenues.

Nor is it clear that the average life even if closely estimated, is all that must be known to enable the computation of correct charges to be made for replacement insurance. It has been observed that if a considerable number of units be put into service a few will last for a period much exceeding the average life. The rate at which the withdrawals of the units remaining in service are made does not

---

[1] These factors have been aptly and clearly enumerated by Mr. Sealy in "Accounting Treatment of Depreciation," 1914 Proceedings of *American Electric Railway Association*, as follows:

(1) Natural wear and tear.

(*a*) Obvious deterioration which is made good by repairs;

(*b*) Invisible deterioration such as a gradual and almost imperceptible weakening of parts, which is above and beyond the maintenance in working order.

(2) Accidental breakage or unusual destruction.

Injury or destruction of property by the elements or by an accident in a manner or to an extent not covered by other insurance.

(3) Obsolescence.

The necessity of replacing apparatus because in the progress of the art, more efficient apparatus has been invented.

(4) Inadequacy.

The necessity of superseding apparatus because the growth of the community or the increased demand of the service, necessitates a plant on a larger scale, making the existing equipment inadequate.

(5) Public requirement.

The necessity of superseding apparatus because the public authorities have required construction by a different method or at a different place to meet the public convenience; for example, the superseding of overhead by underground wires or the changing of the location of poles from one street to another.

[2] See, for example, Reports of the Committee on the Life of Railway Physical Property of the American Electric Railway Association, Proceedings of the Municipal Tramways Association of Great Britain, and the Proceedings of the International Association of Tramways (Internationaler Strassenbahn — und Kleinbahn — Verein).

remain constant but tends to vary in general as indicated in Fig. 12.[1] With large numbers of units, this curve becomes smooth and, as might be expected, corresponds closely to the cumulative probability curve. Experience indicates that this curve will usually be somewhat asymmetrical and more nearly like the curve shown in Fig. 13. The proper

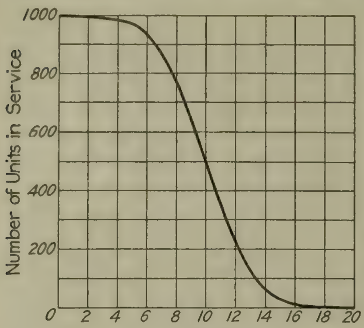


FIG. 12.

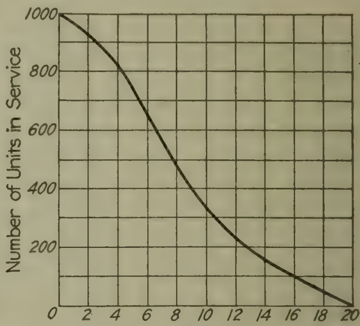


FIG. 13.

cost calculation will consist in computing an annual sum of money which will, with interest accumulations thereon, be sufficient to insure replacement of units abandoned throughout the entire group and is similar to other problems of insurance. The cost of replacing each unit and the number of units to be replaced each year rather than the average life of the group determine the annual credit to the replacement reserve.

The amount standing to the credit of the reserve at any time measures the then present value of the obligation to make future replacements. The reserve may be drawn on at any time, but the exact time cannot be pre-determined and the interest rate on reserve balances should be limited to that obtainable on funds subject to frequent withdrawal or reduction.

If the accrual of the replacement reserves be deferred for a time, the annual charge to be made thereafter for the purpose of financing replacements will evidently be higher. For example, the annual premium for a group of units whose average life is 10.35 years and whose life history is represented approximately by Fig. 13 is 8.49 per cent when begun at age 0. If the accrual of the reserve is commenced at age 5, the annual premium is increased to 12.78 per cent. In the illustrative analysis of cost of service, considered in other chapters, it has been assumed that the accrual of the replacement reserve will be commenced when the physical property is new, since this involves the simplest calculation and is in accord with the usual tests for cost of service made by regulating commissions.

[1] For a mathematical discussion of this subject, see Yule, G. Undy — An Introduction to the Theory of Statistics. Chaps. V, VIII, and XV.

It will be apparent from the foregoing discussion that the amount of utility capital upon which returns are to be computed, and the necessary allowances for capital replacement, are elements of the cost of service, the determination of which will vary in each particular case and concerning which no methods generally applicable have been employed. This absence of a standard method arises from the practical problems involved and in cases of regulation from the diversity of judicial opinion as to the basis of reasonableness. In view of these difficulties, the conclusions which may be summarized are as follows:

(1) In the various conflicting precedents which have been developed by courts and commissions on the question of value, three fundamental theories appear to underlie the determination of fair value, as a basis of regulation; "market value", "sacrifice" and "equivalent agency." In the traction business, when suitable allowances are made for depreciation, and amortization of the difference in value as developed by these theories and the actual investment, the resulting amounts necessarily included in cost of service are not materially different, whichever theory may be followed.

(2) The allowances which must be included in cost of operation to insure replacement of physical property when its usefulness has been terminated, cannot be definitely established until data showing the variation of life under different conditions of operation have been collected, to serve as a basis in the determination of adequate reserves. So-called mortality tables giving average life of units of property, which have been published from time to time, are unreliable and at best do not disclose all the data necessary to the computation of the amount of proper reserves.

(3) Due to the importance of providing for the cost of replacements in the cost of service, both in order to preserve continuity of service and the integrity of the investment, the estimate should in the absence of definite data be liberal and where adjudications of fair value have not been made, the return should be based on actual investment in the utility.

## SELECTED LIST OF REFERENCES ON VALUATION AND DEPRECIATION


### Bibliographies[1]

Meyer, H. H. B.

Valuation and Capitalization of Railroads. *Library of Congress* (1909).

American Electric Railway Accountants' and Engineering Associations. Report of Joint Committee of Life of Railway Physical Property.

Bibliography on Life of Railway Physical Property and on Collection of Tables of Life of Railway Physical Property, 1912 Proceedings, *American Electric Railway Accountants' Association*, page 194, and *American Electric Railway Engineering Association*, page 519.

Rosemand, M. M.

Select list of references on the Valuation of Public Service Corporations prepared for the National Association of Railway Commissioners (Iowa State Library).

American Society of Civil Engineers.

Bibliography on Valuation of Public Utilities, *Jan. 1914* (Bibliography is to July 16, 1913, and is now being extended to date.)

### Books

Whitten, R. H.

Valuation of Public Service Corporations (Volume I, 1912 — Volume II, 1914).[2]

Floy, H.

Valuation of Public Utility Properties, 1912.

Foster, H. A.

Engineering Valuation of Public Utilities and Factories, 1912[2]

Saliers, Earl A.

Principles of Depreciation, 1915.

Wyer, Samuel S.

Regulation, Valuation and Depreciation, 1913.[2]

Hayes, H. V.

Public Utilities, Their Cost New and Depreciation, 1913.

Public Utilities, Their Fair Present Value and Return, 1915.

### Proceedings, American Electric Railway and Allied Associations.[3]

#### American Electric Railway Association

Crosby, O. J.

Physical Valuations — *1911 Proceedings*, page 368.

Wherry, William M., Jr.

Franchise Values — *1913 Proceedings*, page 124.


---

[1] See books marked thus [2].
[2] Contains bibliography.
[3] For other valuable articles published prior to 1911, see Proceedings of American Street and Interurban Railway Association and allied associations.

ROSECRANTZ, C. M.
Other Elements of Value — *1913 Proceedings,* page 136
STEVENS, F. W.
Mooted Principles in Valuation — *1914 Proceedings,* page 23.
DONECKER, H. C.
Organization and Functions of a Valuation Staff — *1914 Proceedings,* page 99.
ARNOLD, BION J.
Foundation Principles of Utility Valuation — *1915 Proceedings,* page 139.

American Electric Railway Accountants' Association

COOLEY, M. E.
Overhead Charges — *1911 Proceedings,* page 169.
HAGENAH, W. J.
Intangible Values of Electric Railways and Their Determination from Accounts — *1912 Proceedings,* page 60.
HATFIELD, H. R.
Some Neglected Phases of Accounting — *1915 Proceedings,* page 149.

AMERICAN SOCIETY OF CIVIL ENGINEERS

RIGGS, H. E.
The Valuation of Public Service Property — *June 1911 Transactions,* page 1.
METCALF, L, and ALVORD, J. W.
The Going Value of Water Works — *Sept. 1911 Transactions,* page 326.
GRUNSKY, C. E.
The Appraisal of Public Utility Properties as a Basis for the Regulation of Rates — *Dec. 1912 Transactions,* page 770.
SPECIAL COMMITTEE TO FORMULATE PRINCIPLES AND METHODS FOR THE VALUATION OF RAILROAD PROPERTY AND OTHER PUBLIC UTILITIES.
Valuation for the purpose of rate making — *Jan. and Mar. 1914.*
ALVORD, J. W.
Fundamental Principles of Public Utility Valuation — *Oct. 1914 Proceedings.*
GANDOLFO, J. H.
The Valuation of Public Utility Property — *Oct. 1914 Proceedings.*
ALVORD, J. W.
Depreciation of Public Utilities as Affecting their Valuation and their Fair Return — *Dec. 1914 Transactions,* page 788.
WILGUS, W. J.
Physical Valuation of Railroads — *Dec. 1914 Transactions,* page 203.

PAMPHLETS, ADDRESSES, ARTICLES, ETC.

BUREAU OF RAILWAY ECONOMICS.

Physical Valuation and Capitalization, *1911*.

DUNN, I. O.

Valuation of Public Utilities from the Railway Point of View — *Journal of Western Society of Engineers (May 1914)*.

ERICKSON, HALFORD.

Valuation of Public Utilities — Address before the Indiana Sanitary and Water Supply Association, 1912.

Making Rates for Electric Plants — Address before Ohio Electric Convention, 1912.

Going Value — Address before the Indiana Electrical Convention, 1914.

FORD, FRANK R.

Valuation of Intangible Street Railway Property — *The Annals of American Academy of Political and Social Science (Jan. 1911)*.

GILLETTE, H. P.

Development Expense as a Factor in the Valuation of Public Service Property — *Electric Traction Weekly (March 11, 1911)*.

The Appraisal of Electrical Properties and Its Uses — *Electric Traction Weekly (Oct. 21, 1911)*.

Two Conflicting Theories of Valuation of Public Service Corporations — *Engineering-Contracting, (Dec. 11, 1912)*.

A Rational Method of Calculating Depreciated Value — *Engineering-Contracting. (July 1914)*.

Handbook of Cost Data.

JURGENSEN, D. F.

Railroad Valuation Reproduction Cost New as a Sale Basis for Rates — *Journal Associated Engineering Societies of Boston, (Dec. 1912)*.

MCPHERSON, L. G.

Five Lectures concerning Transportation, 1914.

THE PUBLIC SERVICE COMMISSION OF PENNSYLVANIA.

In Re: Tentative Schedule of Telephone Rates — Brief on behalf of the Bell Telephone Co. of Pennsylvania, April 1915, pages 117–206. Addison Candor, John L. Swayze, Robert V. Marye.

REPORT OF COMMITTEE ON INTERSTATE COMMERCE OF THE U. S. SENATE.

Valuation of the Several Classes of Property of Common Carriers — *62nd Congress Third Session, Senate Report No. 1290 — (1913)*.

WHITTEN, R. H.

Fair Value for Rate Purposes — *Harvard Law Review, (March, 1914)*.

WILLIAMS, W. H.

Valuation of Public Service Corporations — *American Economic Association, (Dec. 1909)*.

Woolfolk, William G.
Appraisal of Public Utility Properties — Address before Indiana Gas Association, March 1915.

A discussion of court and commission decisions on questions of valuation and depreciation may be found among other sources in Whitten, Stevens, Public Service Commission of Pennsylvania in re: Tentative schedule of telephone rates quoted above. The following references are to very recent cases:

Wisconsin Supreme Court.
Duluth Street Railway Company vs. Railroad Commission of Wisconsin; 152 N. W. 887, P. U. R. 1915 D. 192.

Idaho Supreme Court.
Pocatello Water Co. vs. Idaho Public Utilities Commission; 150 Pac. 47.

Idaho Public Utilities Commission.
The City of Sand Point v. Sand Point Water and Light Co. October 2, 1915.

Depreciation

In addition to treatment of this question in connection with discussions on valuation, see:

Allison, J. E. (Public Service Commission of St. Louis).
Should Public Service Properties be Depreciated to Obtain Fair Value in Rate or Regulation Cases, 1912.

Erickson, Halford.
Depreciation — Address before Central States Water Works Association, Sept. 1912.
Some Facts Relating to Depreciation and Rate Making — Address before Wisconsin Electrical Association, Jan. 1914.
Depreciation Problems — Address before National Gas Institute, Oct. 1914.

Gruhl, Edwin.
Depreciation Estimates — Aera, March 1913.

Halford, Geo.
Depreciation and Renewals Funds 1905–6 Proceedings, *Municipal Tramways Association of Great Britain.*

Haselman, A.
Depreciation Funds — 1904 Proceedings, *International Association of Tramways.*

Humphreys, Alex. C.
Depreciation, Estimated and Actual — Address before Institute of Gas — *Engineering News,* (*Sept. 15, 1913*).

Jackson, W. B.
Discussion of Depreciation Problem with Particular Reference to Electric Railways — *Engineering-Contracting,* (*Feb. 8, 1911*).

Kealy, Philip J.
A Discussion of Depreciation — *Engineering-Contracting,* (*August 12, 1915*).

McClellan, William.

Life of Railway Physical Property — 1913 Proceedings, *American Electric Railway Accountants' Association,* page 212.

Sealy, Robert.

Accounting Treatment of Depreciation — 1914 Proceedings, *American Electric Railway Accountants' Association,* page 145.

The Joint Committee on Life of Railway Physical Property of the American Electric Railway Accountants' and American Electric Railway Engineering Associations has reported annually since 1911. For its reports see Proceeding of these above Associations.

Extended discussion of valuation and depreciation will be found in the files of the technical press and publications dealing with economics, accounting, and the operation of public utilities; — proceedings of the National Electric Light and other public utility associations; — annual reports of public service and railroad commissions, particularly those of the Wisconsin Railroad Commission, and the proceedings of the National Association of Railway Commissioners.

## CHAPTER VI

### ACTUAL RETURNS IN THE TRACTION BUSINESS

Relation of Reasonable Return to Cost of Service,—— Actual Returns upon Various Theories of Value,—— Factors Determining the Reasonableness of Returns in the Traction Business.

There is a general tendency to refer to return upon investment as something separate and apart from cost of service. It is in fact one of the most important factors of cost. This is particularly true in a business which requires additional capital for its development. In the case of street railways where development is closely associated with community growth, the continuance of a sufficient rate of return to attract additional investment is of public interest. It is obvious that any computation of actual cost or "reasonable" cost must include return upon the investment.

Considering the traction industry in its entirety it is evident that the present returns are very meager. From the publications of the Census Bureau it appears that electric railways throughout the country paid interest in 1912 at the rate of about 5 per cent, and paid dividends at the rate of about 2½ per cent. The results for 975 operating companies were as follows:

| | |
|---|---|
| Interest Bearing Debt | $1 999 400 000 |
| Interest paid | 98 025 300 |
| Rate of per cent | 4.90 |
| Capital Stock | $1 957 300 000 |
| Dividends paid | 51 650 100 |
| Rate per cent | 2.64 |

Inasmuch as the amount of outstanding stock is substantially equivalent to the amount of bonds which have been issued, it is apparent that if the stock is considered to represent no investment whatever, the returns in the electric traction industry amount to about 7 per cent. Elsewhere in the Census Bulletin, it is made plain, however, that the capital stock is fully represented by investment in the various properties and that as a matter of fact, the difference between the investment and the funded debt is substantially in excess of the outstanding capital stock. While there has been in the electric railway industry, as in every other industry, the issue of stock from time to time, as a bonus to purchasers of bonds and to others at a price less than the par value of the stock, the very frequent re-organizations which have followed upon the generally unsatisfactory financial results of operation have served to eliminate the major part, if not all, of such securities. It is obvious that it is impossible to issue bonds to the full value of the property by which they are secured at the time of issue. Assuming the somewhat high ratio of 80 per cent as

existing between the amount of the loan and the value of the property which secures it, a rate of return of 7 per cent on the debt would be equivalent to a rate of but 5.6 per cent on the value of the property.

A study of a number of the reports of regulating commissions indicates that there is being paid out in interest and in dividends at the present time, an amount of money entirely incommensurate with the investment in the properties. The reports of the Railroad Commission of Wisconsin for the years ended June 30, 1908–1913, inclusive, show an average net divisible income of 4.64 per cent on capital stock of traction companies with dividends declared of 4.27 per cent. Covering this six year period, 147 reports were examined, and of these 18.5 per cent indicated a more or less complete failure to earn fixed charges and only 44 per cent of the companies were able to declare dividends, the average dividend rate being 5.55 per cent. There are available reports covering the operation of electric railways in Massachusetts for the twenty years, 1895 to 1914 inclusive. During this period there has been a strict regulation of security issues and in 1914, the average investment per mile of track was $70,647, while the securities outstanding amounted to $70,180 per mile of track. The average dividend rate throughout the twenty years was 5.28 per cent. The surplus accumulated during the period increased from 3.06 per cent to 11.18 per cent of the capital invested. This increase of 8.12 per cent in twenty years indicates an additional earning of 0.4 per cent per year, so that the average divisible income has been about 5.68 per cent. Only 17 out of 68 traction companies reporting to the Railroad and Warehouse Commission of Illinois declared dividends in 1912. As a result of such returns where the miles of single track of electric railways in the United States in the five years from 1902 to 1907 increased 52.3 per cent, in the five years 1907 to 1912 the increase was only 19.4 per cent. Similarly where the number of cars owned increased 25.2 per cent in the period from 1902 to 1907, the increase was 12.4 per cent in the period 1907 to 1912.

As compared with these returns it is interesting to note the returns of competitive businesses not subject to regulation. The testimony and exhibits presented in evidence by Joseph E. Sterrett, of Price, Waterhouse & Company, before the Public Service Commission of Pennsylvania in the matter of Tentative Schedule of Telephone Rates proposed by the Pennsylvania Railroad Commission, are significant.

With respect to "Exhibit 4-O", Mr. Sterrett testified as follows:

> Q. Have you with you a statement, which you can file with the Commission, showing the earnings in a representative number of manufacturing industries in this country?
>
> A. I have here a statement which I have prepared from private records in our own office. This is not aimed to be an exhaustive statement. It was merely taken as indicative of what I think are general conditions. In preparing it there was no attempt made to select companies. As a matter of fact, what I did was to take

from our files a pile of these reports, statements and accounts that had been prepared, and I took them as they came, throwing aside the reports from Western offices and confining myself to reports that had been made in the New York-Philadelphia-Pittsburg district, and one or two Boston reports.

(The witness produced a statement, which was marked "Exhibit 4-O.")

## EXHIBIT 4-O

Statement Showing Return on Investment in Sundry Manufacturing Corporations Not Under Governmental Control

(Taken from Private Records)

| Company | Period | Average annual net investment | Average annual profit | Percentage of profit to investment |
|---|---|---|---|---|
| 1 | 1913 | $9,557,242 | $779,415 | 8.14 |
| 2 | 1912 | 2,392,010 | 156,745 | 6.55 |
| 3 | 3 years to 1913 | 11,646,244 | 1,789,433 | 15.37 |
| 4 | 1913 | 376,125 | 61,865 | 16.44 |
| 5 | 3 years to 1913 | 151,018 | 46,315 | 30.67 |
| 6 | 1913 | 525,078 | 88,973 | 16.94 |
| 7 | 3 years to 1913 | 1,368,722 | 161,485 | 11.80 |
| 8 | 3 years to 1913 | 288,031 | 33,161 | 11.51 |
| 9 | 3½ years to 1913 | 677,404 | 293,354 | 43.30 |
| 10 | 3 years to 1913 | 5,112,926 | 385,415 | 7.54 |
| 11 | 3 years to 1913 | 2,390,725 | 341,126 | 14.27 |
| 12 | 2 years to 1913 | 10,909,986 | 3,740,196 | 34.30 |
| 13 | 1913 | 3,607,648 | 1,204,921 | 33.40 |
| 14 | 1913 | 1,410,840 | 62,106 | 4.40 |
| 15 | ½ year to 1913 | 97,044 | 21,378 | 44.06 |
| 16 | 1913 | 1,560,704 | 21,390 | 1.37 |
| 17 | 1913 | 1,716,176 | 123,870 | 7.22 |
| 18 | 1913 | 2,238,109 | 538,874 | 24.08 |
| 19 | 1913 | 1,392,216 | 115,141 | 8.27 |
| 20 | 1913 | 1,099,212 | 42,715 | 3.89 |
| 21 | 1913 | 371,122 | 57,036 | 15.37 |
| 22 | 1913 | 3,010,087 | 330,735 | 10.99 |
| 23 | 1913 | 1,438,225 | 131,332 | 9.13 |
| 24 | 1913 | 490,597 | 48,522 | 9.89 |
| 25 | 1913 | 3,799,603 | 225,115 | 5.92 |
| 26 | 1913 | 11,452,084 | 594,390 | 5.18 |
| 27 | 1913 | 2,928,370 | 262,605 | 8.97 |
| 28 | 1913 | 950,821 | 116,705 | 12.27 |
| 29 | 1913 | 22,131,599 | 1,917,605 | 8.66 |
| 30 | 1913 | 337,794 | 78,919 | 23.36 |
| 31 | 1913 | 1,726,558 | 229,941 | 13.31 |
| 32 | 1913 | 248,129 | 53,279 | 21.47 |
| 33 | 1913 | 658,896 | 108,027 | 16.39 |
| 34 | 1913 | 95,395 | 69,680 | 73.04 |
| 35 | 1913 | 460,458 | 516,138 | 112.09 |
| 36 | 1913 | 304,271 | 17,045 | 5.60 |

Note.— Insofar as practicable, intangible values have been excluded from the amounts of investment shown above.

Q. Did you select them for the purpose of showing prosperous concerns?

A. Not at all. As a matter of fact I did not look at the inside of the reports. I picked them out, recognized their names, and laid these in a pile by themselves and turned them over to one of my clerks to prepare this table.

Q. What does this statement, marked "Exhibit 4-O", purport to represent?

A. This statement represents the amount of the investment in tangible property in a number of companies, some thirty-six in all; the amount of profit that has been made for these companies, for the most part during the year 1913, which was not a particularly prosperous year, and the percentage of that profit to the investment. So far as possible the intangible values have been eliminated, although, in some instances, I think it is possible that there may be some intangible values included.

Q. You have attempted to exclude that?

A. So far as we could, we excluded it, but in some cases, where we did not have anything in the nature of an appraisal of the property, something may have been included, at some past date, and no longer clearly disclosed.

## EXHIBIT 4-P

STATEMENT SHOWING RETURN ON THE INVESTMENT IN SUNDRY TRADING CORPORATIONS NOT UNDER GOVERNMENTAL CONTROL

(Taken from Private Records)

| Company | Period | Average annual investment | Average annual profit | Percentage of profit to investment |
|---|---|---|---|---|
| 1 | 1913 | $361,543 | $9,186 | 2.54 |
| 2 | 2 years to 1913 | 12,781,254 | 1,854,750 | 14.51 |
| 3 | 1913 | 642,278 | 31,759 | 4.94 |
| 4 | 1913 | 275,213 | 20,656 | 7.50 |
| 5 | 1913 | 951,769 | 188,896 | 19.85 |
| 6 | 1913 | 76,140 | 16,132 | 21.19 |
| 7 | 1913 | 1,796,131 | 132,767 | 7.39 |
| 8 | 1913 | 63,943 | 9,292 | 14.52 |
| 9 | 1913 | 62,761 | 21,421 | 34.13 |
| 10 | 1913 | 31,840 | 6,489 | 20.38 |
| 11 | 1913 | 32,013 | 2,113 | 6.60 |
| 12 | 1913 | 129,257 | 30,708 | 23.76 |
| 13 | 1913 | 828,375 | 63,667 | 7.70 |
| 14 | 1913 | 127,553 | 26,557 | 20.82 |
| 15 | 1913 | 2,901,236 | 869,686 | 29.97 |
| 16 | 1913 | 838,003 | 150,811 | 18.00 |
| 17 | 1913 | 274,165 | 25,653 | 9.36 |
| 18 | 1913 | 549,951 | 46,096 | 8.38 |
| 19 | 1913 | 2,875,145 | 537,930 | 18.71 |

NOTE.— Insofar as practicable, intangible values have been eliminated from the amounts of investment shown above.

With respect to statement "Exhibit 4-P", Mr. Sterrett testified as follows:

Q. That was prepared from the records of Price, Waterhouse & Company?

A. Yes.

Q. And you are familiar with the companies listed in this statement which is marked 4-P?

A. Yes, Sir.

Q. This statement is fashioned up exactly as your statement 4-O?

A. Yes, Sir.

Q. The left hand column shows the company, the next column the period, the third column the average annual net investment, the fourth the average annual profit and the fifth the percentage of profit to investment?

A. Yes.

Q. Did you, in this statement, also attempt to exclude intangible values?

A. So far as practicable. I think that in one or two instances there are some intangible values.

Q. This statement 4–P is confined or not to trading corporations?

A. Yes.

Q. Are they public utilities? Are they under governmental control in any way?

A. No.

It is a matter of common knowledge that from $4 to $8 of investment are required in the electric railway business to produce annually $1 of gross earnings. From this it is apparent that the rate of return must necessarily be low with present rates of fare. With an operating ratio of 70 per cent and an investment of $5, one dollar of gross revenue will permit a return of less than 5 per cent after provision is made for taxes.

It was the belief of a considerable part of the public some years ago, that the creation of utility commissions with power to examine into the earnings of public utilities and with power to see that these earnings should be no more than reasonable would bring about a reduction of fares in a considerable number of cases. Commissions investigating the matter have quite generally found this to be impossible. Five cases which were decided during 1914 have a very direct bearing on this problem, and serve to indicate that commissions are finding upon examination that the electric railway industry is not making exorbitant profits and that instead of reduced fares, many communities may look in the future for increased fares or decreased service.[1]

Thus, in the complaint of the City of Schenectady against the Schenectady Railway Company, arising out of the Company's refusal to sell six tickets for 25 cents, Commissioner Emmet of the Public Service Commission for the Second District of New York (May 20, 1914) in dismissing the complaint, found in part as follows:

> * * * But even if the City's views as to the value of the company's property were all absolutely correct, still the return would only represent a yield of between eight and nine per cent on such valuation, and this percentage would of course be materially reduced if any considerable portion of the cost of complying, from time to time, with the provisions of the Public Service Commissions Law and with the orders of this Commission were to be met out of current earnings instead of out of capital.

In the case of the Middlesex and Boston Street Railway Company, the Public Service Commission of Massachusetts in upholding the

[1] See F. W. Doolitlle — Five Commission Decisions, Area April, 1915.

increase in rates of fare from five to six cents (October 28, 1914) found in part as follows:

> Under Massachusetts law, the honest and reasonably prudent investment represented under normal conditions by the capitalization must be taken as basis of reckoning fair and reasonable rates.
>
> Reproduction cost may be considered but is not to be taken as the determining basis.
>
> * * * The Commission is driven irresistibly to the conclusion that at no time have the rates charged been adequate to meet the fair cost of the service. The average dividend paid upon the capital stock of the constituent companies before consolidation was 3.09 per cent and since consolidation, 4.35 per cent. Hitherto as between investors in, and patrons of, this street railway company, the patrons have had much the better of the bargain.
>
> It is in the public interest that street railway companies should have such income as may enable them to furnish safe and adequate transportation service, and such credit as to enable them to obtain necessary capital to provide for the increasing demands of our growing communities.

Again, in the Manchester (N. H.) case where the New Hampshire Public Service Commission was petitioned to require the Manchester Street Railway Company to issue school tickets at the rate of 25 for $1 and tickets good only during rush hours at the rate of six for 25 cents, the Commission in denying the request for six for 25 cent tickets (November 20, 1914) held in part as follows:

> * * * While it is clearly settled by decisions of the Supreme Court of the United States that there is no constitutional right to demand a return upon more than the present depreciated value of the property, it is also clear that justice may often require that a return be allowed upon a larger sum.
>
> * * * Justice requires that the deficiency in the present depreciated value below the amount actually invested should be regarded as a cost of developing the business; and added to the depreciated value to determine the present fair value of the property * * *.
>
> The margin (for dividends) is not such as to justify an order requiring a reduction in the price of tickets to the general public.

In the complaint of the City of Rochester against the New York State Railways asking for a reduction of the five-cent fare to three cents during rush hours, the Public Service Commission for the Second District of New York, in dismissing the complaint (February 16, 1915), found in part as follows:

> This Commission should not, if it could, strike down the revenues of this Company to effect a reduction of fare and leave its resources for improving and keeping up the efficiency of its service insufficient for that prime purpose.
>
> No probable increase in traffic, resulting from the proposed reduction in fares, would amount in profit to the company after payment of increased operating expenses caused by use of any additional equipment for this rush hour travel, to such sum as would increase the percentage return of 4.55 per cent to any fair return upon the agreed valuation.

> A six per cent return upon a capital employed in the public service has been deemed to be a minimum fair return, and this after all other allowances necessary to the conduct of the business shall have been made. In many cases a considerably higher rate of return has been held to be required.
>
> On the basis of the valuation which the parties have agreed to use in this case * * * the company's income after paying operating expenses, taxes, etc. * * * gave it 8.58 per cent on such valuation.

The Commission did not regard the above return as excessive as evidenced by its decision denying the decrease in rates of fare. The Commission held that:

> * * * no common rule exists or can exist governing the primary treatment of rate complaints in determining whether the rate complained of is unreasonable and what rate is reasonable; and this is a peculiar example of a proceeding in carriers' cases, where there are no preliminary considerations by which to determine whether a passenger fare is in and of itself or as applied to the community in general, unreasonable or unjust, and where it must be assumed that the fare challenged is not unreasonable unless it is made to appear that the respondent's revenue is so much in excess of a fair return that the demanded reduction would be fair and reasonable and required in the public interest.

Finally in the petition of Christ. Woehnsner, Mayor of Cudahy, Wisconsin, asking for the restoration by the Milwaukee Electric Railway and Light Company of tickets at the rate of 25 for $1 as against the rate of 13 for 50 cents ordered by the Railroad Commission of Wisconsin on August 23, 1912, the Commission in rescinding its order and restoring the old ticket rate of 25 for $1 (January 30, 1915) found in part as follows:

> Justice and law demand that the rates charged by public utilities for the services they render shall be reasonable to the utilities as well as to their patrons. The best interest of the greatest number in matters of this kind can as a rule be best promoted by allowing rates that are high enough to cover the cost of reasonably adequate service * * *.

The following tables from the above decision are of particular interest in this connection.[1]

Respondent's Bases

Summary of The Milwaukee Electric Railway and Light Company Income Accounts, 1912–1914

| | 1912 | 1913* | 1914 |
|---|---|---|---|
| Cash investment | $16,563,559 | $17,508,284 | $19,246,548 |
| Per cent return | 6.377 | 5.906 | 3.634 |
| Commission's earning value | 12,502,836 | 13,862,874 | 15,441,000 |
| Per cent return | 8.448 | 7.460 | 4.530 |
| Tax Commission's value | 18,191,000 | 18,700,000 | 20,235,104 |
| Per cent return | 5.806 | 5.530 | 3.457 |

* Fiscal year ending June 30.

NOTE.— Values under 1912 and 1913, as of January 1. Values under 1914 as of June 30.

[1] In re: Modification Milwaukee Urban Fare Decision, 15 W. R. C. R. 746, 749.

### Respondent's Bases

### Summary of Milwaukee Light, Heat and Traction Company Income Accounts, 1912–1914

| | 1912 | 1913* | 1914* |
|---|---|---|---|
| Cash investment | $7,781,305 | $7,890,635 | $8,124,627 |
| Per cent return | 2.800 | 2.907 | 3.739 |
| Commission's earning value | 6,184,929 | 6,195,208 | 6,274,889 |
| Per cent return | 3.523 | 3.702 | 4.841 |
| Tax Commission's value | 5,780,000 | 6,900,000 | 7,084,000 |
| Per cent return | 3.769 | 3.324 | 4.289 |

* Year ending June 30.
Note.— Values as of January 1.

### Summary Income Accounts

### The Milwaukee Electric Railway and Light Company and Milwaukee Light, Heat and Traction Company

Calendar years 1912, 1913 and 1914

| | 1912 | 1913 | 1914 |
|---|---|---|---|
| **The Milwaukee Electric Railway and Light Company** | | | |
| Operating revenues | [1] $4,131,811 34 | [1] $4,221,310 50 | [1] $4,110,717 78 |
| Total expenses | 2,930,170 80 | 3,239,658 18 | 3,291,013 02 |
| Surplus available for returns | $1,201,640 54 | $981,652 32 | $819,704 76 |
| Cost of reproduction new as of January 1 | $12,171,369 00 | $13,463,859 00 | $15,027,019 00 |
| Per cent return upon cost of reproduction new as of January 1 | 9.87 | 7.29 | 5.45 |
| **Milwaukee Light, Heat and Traction Company** | | | |
| Operating revenues | $923,383 43 | [2] $1,074,521 97 | [3] $1,041,258 59 |
| Total expenses | 784,768 14 | 828,290 03 | 887,200 39 |
| Surplus available for returns | $138,615 29 | $246,231 94 | $154,058 20 |
| Cost of reproduction new as of January 1 | $6,422,007 60 | $6,531,337 00 | $6,765,329 00 |
| Per cent return upon cost of reproduction new as of January 1 | 2.16 | 3.77 | 2.28 |
| **The Milwaukee Electric Railway and Light Company and Milwaukee Light, Heat and Traction Company Combined** | | | |
| Operating revenues | $5,055,194 77 | $5,295,832 47 | $5,151,976 37 |
| Total expenses | 3,714,938 94 | 4,067,948 21 | 4,178,213 41 |
| Surplus available for returns | $1,340,255 83 | $1,227,884 26 | $973,762 96 |
| Cost of reproduction new as of January 1 | $18,593,376 00 | $19,995,196 00 | $21,792,348 00 |
| Per cent return upon cost of reproduction new as of January 1 | 7.21 | 6.14 | 4.47 |

[1] Excluding $24,278.97, $81,915.87, and $77,354.48, amounts in the "Redemption reserve fund" for 1912, 1913, and 1914, respectively.
[2] Includes $99,641.31, rental for M. L. H. & T. Co. track used by T. M. E. R. & L. Co.; and a small amount for track rented from the city of Milwaukee.
[3] Includes $100,199.28, rental for M. L. H. & T. Co. track used by T. M. E. R. & L. Co.; and a small amount for track rented from the city of Milwaukee.

While these decisions follow various theories of value, the results indicate that in very many cases, upon any theory of obtaining the amount on which to calculate the returns to which a company is entitled, similar conclusions of insufficient returns must be drawn.

It must not be overlooked that it has been held that unremunerative rates are not justified on the theory that they aid in the development of any locality. Thus, in the case of the Northern Pacific Railway Co. vs. North Dakota (March 8, 1915), Justice Hughes for the United States Supreme Court held in part as follows:

> But, while local interests serve as a motive for enforcing reasonable rates, it would be a very different matter to say that the state may compel the carrier to maintain a rate upon a particular commodity that is less than reasonable, or — as might equally well be asserted — to carry gratuitously *in order to build up a local enterprise.* * * *
>
> We cannot reach the conclusion that the rate in question is to be supported upon the ground of public policy if, upon the facts found, it should be deemed to be less than reasonable.

Subsequent to the above decision of the United States Supreme Court, the following quoted from the decision of the New Jersey Board of Public Utility Commissioners in the case of C. A. Nutting vs. Public Service Railway Company (April 27, 1915), is of particular interest to electric railways.

> The reasonable rate of a street railroad company cannot be reduced merely on the theory that it will result in the development of the community served.

It is also of interest in this connection to note the results in Cleveland[1] where in 1910 the Cleveland Railway Company commenced operation under an agreement designed to provide a fixed rate of return on a definite value. This value was substantially the cost to reproduce as of the date of valuation less depreciation of 30 per cent, or eight and a quarter million dollars. During the five years of operation under agreement, something less than 6 per cent has been paid on the depreciated value and considerably less than this amount has been earned. This can not be termed an ample rate of return on the agreed valuation and much less is it to be considered reasonable on other theories of value.

As has been frequently pointed out, there is no rate of return which is equally reasonable under all conditions. What has been termed the pure money rate,[2] is based on the cost of money to the Federal Government and certain municipalities of unquestioned credit, and may be taken to represent as at any time the minimum rate which may be expected for the use of money where safety is at a maximum and where convenience of investment and opportunity to convert securities into funds are all present.

---

[1] Chapter XXVI, page 425
[2] See Chapter IV, page 48

It will be of interest in this connection to point out some of the factors which appear to govern to a greater or less extent the rate necessary to attract investment capital. In considering these factors it must be borne in mind that the electric railway competes actively with all other industries for capital. The following table appearing in *The Annalist* (New York), October 25, 1915, while it will not be generally accepted without important qualifications, is of interest.

### Relative Investment Rank of Five Types of Public Utility Companies

Table Showing Relative Value of Five Different Public Service Securities on the Basis of Eight Criteria of Judgment, as Compiled by Arthur S. Dewing, Ph.D., and Published by Marshall & Co., Inc.

| Difficulties | Water | Gas | Steam electric | Hydro-electric | Electric railway |
|---|---|---|---|---|---|
| Danger of difficulty with municipalities | Poor | Fair | Fair | Good | Poor |
| Unknown elements | Good | Good | Good | Very poor | Poor |
| Fluctuation of labor | Very good | Good | Good | Very good | Very poor |
| Fluctuation of raw material | Very good | Good | Good | Good | Fair |
| Predictability of depreciation | Good | Good | Fair | Good | Very poor |
| Influence of change of management | Very good | Good | Good | Good | Poor |
| Influence of change of rate | Poor | Good | Good | Good | Poor |
| Fluctuations in gross earnings according to business depressions | Very good | Good | Fair | Poor | Fair |
| Relative excellence as based on general estimate without special engineering knowledge | 1 | 2 | 3 | 4 | 5 |

The factors which influence the interest rate from the standpoint of the investor may be grouped roughly under the following heads: Safety; Availability; and Conventibility.

The security in which the element of risk is a minimum, which is available at any time and which may be converted into funds at any time, will command the lowest rate of interest and as any one of these three factors varies, the rate must rise in order to maintain the par value of the security. While the deposit of money in a savings bank is not entirely comparable to the purchase of securities, the low interest rates there paid rest upon the safety of the savings bank deposit, the fact that additional deposits may be made at any time, and the fact that the deposit can be converted into cash on short notice. Other loans to banks which must be left for stated periods are equally safe and equally available but ease of conversion is not so great and we observe in this case a distinctly higher level of interest rates. Certain types of real estate mortgages may be con-

sidered as ranking high in the scale of safety and they can be disposed of at any time to the buyers of such instruments, but they are not as available as the opportunity of the deposit of money in banks and they carry with them a higher interest rate, representing the operation of the two factors, safety and availability. In industrial and utility issues, safety is measured by the excess of net income over the demands made upon this income by all securities which have a claim prior to the one whose safety is under consideration. With such securities the rate of return demanded upon a note or bond which is well secured is less than the returns demanded upon funds which are unsecured and dependent entirely upon the vicissitudes of the business.

The decisions of courts and commissions usually do not define the elements which have been considered in fixing the rate of return held to be unremunerative, or the return which might be considered confiscatory. These may be expected to vary with the size of the industry, its geographical location, and the assurances which exist of stable net earnings in the future through the operation of guarantees. Such decisions as those of the Wisconsin Railroad Commission which have commented extensively upon factors affecting rate of return appear to group these factors under three headings: (1) The rate of interest or compensation for money advanced; (2) Insurance or indemnity for risk involved; and (3) The wages of management.

It is evident from the discussion of tendencies of operating costs that the traction business is one of peculiar hazard.[1] Progressive increases in cost in recent years have materially affected the margin

---

[1] J. D. Mortimer, in his paper "Risk as an Element of the Rate of Return," AERA, April, 1913, states:

The risks peculiar to the traction industry, which differentiate it from other public utility industries may be summarized under three principal groups:

(a) Risks affecting gross earnings.

(b) Risks affected by probability of increased operating expenditures in the future.

(c) Risks affected by municipal demands for unproductive capital expenditures.

All of these are in a large measure beyond the control of the management and operate to make net earnings and capital return unstable.

These hazards place the traction utility business in a class distinct from that of other utilities. The quantitive measurement of the relative risk involved in investments in different classes of municipal utilities has not been attempted but it affords a fruitful field for statistical research. For the present we must content ourselves with conclusions that are based on the results rather than on the causes. Investments in traction utilities are not now being freely made even under market conditions that create an active demand for securities of other public utilities. Both the conservative and speculative investor has been disappointed in the past and turns toward fields where the grass is longer and the crop more certain. He is prone to generalize and may at times unjustly discriminate against a meritorious investment because it is of a class that does not bear a good reputation. If the elimination of the hazards is impossible because they are inherent in the business, attractive traction securities can be developed only through greater investment returns. Such is not possible with any rate of return so far used by any regulating commission in estimating the cost of service and there must necessarily be a substantial revision of the public's ideas on this subject or the capital necessary for the development of the traction systems of this country will not be forthcoming.

between earnings and expenses which make for stability of the investment. Earnings have been stationary or have decreased with demands for extensions of area served, for increased transfer privileges and the prescribing of more costly service standards. Political agitation and the litigation arising from regulation and the expiration of franchise grants have had a further influence in deterring investors. Finally the possibilities of remunerative investment in other fields have brought demands for higher returns and this, with lower margins of profit, have combined to reduce effectively the amounts of added capital contributed to the business in recent years.

## CHAPTER VII

### UNITS OF COMPARISON

Unreliability of the Single Unit of Comparison,—— Adaptability of Specific Units to General Analysis,—— Use of Units of Comparison in Cost Analyses,—— Practical Limitations of Accounting Classifications and Statistical Data,—— Fixed and Variable Expenses, Treatment of Specific Accounts,—— Typical Schedule of Apportionment,—— Technical Notes on Statistical Processes to Determine Functional Relation Between Units of Comparison and Operating Cost Items.

Measurements of relative size or worth necessitate some standard of comparison. The cost of operation of a street railway in one city may be twice that in another. The area of one city may be 40 per cent greater, its population 90 per cent greater, the miles of single track 60 per cent greater, the number of cars operated 110 per cent greater, and the number of passengers carried 130 per cent greater. Different conclusions will be reached as to the relative costs of operation in these two cities, depending upon the unit of comparison used. The statement may be made: "Company A operates only 60 per cent more track, yet its operating costs are twice as great as Company B," or "Company B carries 130 per cent more passengers than Company A, yet its operating costs are only twice as great." Both statements would be misleading, because both arise from improper standards of comparison. Total operating cost does not vary with, or have a direct functional relation to, either the unit "miles of single track operated," or the unit, "total passengers carried." Even were all the above relations identical, the comparison might be subject to important qualifications. The topography of the two cities, the lay-outs of the lines, the standards of wages, and similar factors, might be so different as to explain fully the apparent differences in unit costs.

There is no more specious generalization than that based upon improper units of comparison, and the determination of a proper basis follows only upon a careful analysis of units and costs.

Unlike many other businesses, that of the electric railway has no general unit of comparison or all-including common denominator which can be applied alike to revenues, investment and total costs of operation. It is true that the typical urban street railway system sells but one commodity,— passenger transportation, and it would accordingly appear that "the passenger" would be a comprehensive unit of comparison. But the service which the street railway renders different passengers for the same price varies greatly. The street railway will carry a passenger a block or ten blocks or perhaps ten miles for a nickel. It will sell this varying quantity of service at the same price at all times of the day and of the year. While five cents may cover the total cost of service for the average ride this year,

it will not do so next year when there are more passengers riding greater distances, unless there is at the same time a corresponding increase in the number of passengers riding shorter distances, so that the *average length of ride* is unchanged. The cost will also increase if the added service demanded comes at the time of the peak load, when the system from fireman to fare collector is under its greatest strain and when the added costs far exceed the added fares received. The number of hours or miles cars are operated are similarly unsatisfactory as single units for comparing costs and revenues. The cost of furnishing service to the extent of 240 car hours per day is obviously greatly different when rendered by 20 cars operated twelve hours each than when rendered by 240 cars operated for one hour each. The operation of a car 15 miles in one hour will probably show a very different cost per mile than would be the case where the speed is five miles per hour. Figures presented in the *American Electric Railway Association Year Book,* 1914–15, Table VIII, page 303, show the relative change in cost per car hour and in cost per dollar of revenue over a period of ten years, and illustrate clearly that neither the car mile nor the dollar of gross revenue are satisfactory general units for comparing costs. It is apparent therefore that the use of specific units of comparison is limited. Comparisons are of value only when several units are jointly used or when a single unit is applied to certain portions of operating expense.

The acceptability of any unit as a measure of specific items of cost or revenue must be determined having in view the purpose of the comparison to be made. The investor is interested only in general ratios as his judgment adds sufficient factors of safety to compensate for his lack of accurate knowledge. These ratios are usually computed according to a particular rule of thumb by which certain units are divided into certain operating revenues, operating expenses, costs of construction, or securities outstanding, due allowances being made for favorable or unfavorable circumstances in making comparisons with other results. Thus, if the earnings per mile of track decrease, other things being equal, it is a sign of over-extension; if the gross earnings per mile operated are less than certain preconceived ideas of what such earnings should aggregate, the wisdom of additional construction is questioned; if the ratio of operating expenses to operating revenues decreases, it is an indication of increase in revenues or better efficiency of operation or both; if the operating revenues per mile operated are small, and the operating ratio low, it may be that the road is not being properly maintained; and, if the ratio of fixed charges to income is increasing, it may be that there are financial difficulties, etc. The passenger, the mile of track, and the car mile are the units usually contained in financial manuals for such general purposes and their value depends upon the skill and judgment with which they are interpreted. The application of units of comparison to

analyses of cost necessitates a more careful choice of units than is usually made in general comparisons, such as those in which the student of investors' manuals is interested, and the application of units to certain problems of management demands an even greater discrimination in the interests of accuracy. The use, instead of the unit car miles, of wheel-passes over special work, wheel miles, ton miles, seat miles and car miles, as corrected by percentage of coasting, are instances in point.

Units of comparison are necessary in cost analyses, as bases of prorating and apportioning separate items of cost and reducing such costs to terms of units of service. In a large property it is impossible to segregate actual operating expenses for a particular line or route, or for a particular geographical location, such as a zone or given area or for a particular hour of the day. To do so would enormously complicate the work of the accountant and would serve no useful purpose, since the information conveyed would be of only occasional service. It is possible to determine, however, the unit of comparison with which a specific item of operating expense may be expected to vary, determine the unit cost by dividing by the total units of comparison and apply the average unit cost thus obtained to line, route, geographical area, or hour, as the case may be. If the premises are correct, it will be possible to construct approximately a schedule of expenses and an income account of any cross section or part of the business. The units with which the operating expenses may be expected to vary can be determined by an examination of the trend of increase and decrease of expenses as compared with the trend of increase and decrease of specific units.[1]

The reliability of an estimate based upon unit costs will depend upon the care with which the units are selected. The test of such a selection must be that the addition or deduction of any number of units will have no material effect upon the unit cost. In brief, the unit cost must be a constant.

There are two practical limitations to such an application of units of comparison; one of these is the limitation of classifications of accounts. The scheme of accounting for electric railways has been a gradual development and has quite naturally followed the practice of steam roads. The purpose of the classification has been to show the disposition of the road's earnings and the division of expenses by departments. Expenses have been grouped for the purpose of determining departmental responsibility and not with reference to specific units with which such expenses may be expected to vary.[2] Certain detailed accounts, such as wages of conductors, may be expected to vary with the car hours, since conductors are usually paid on this

[1] For an explanation of statistical methods for determinations of correlation, see Technical Notes at the close of this chapter.

[2] For a description of the limitations of standard accounting classifications, see King — Municipal Utilities — Uses and limitations of standard classifications of accounts.

basis. Other detailed accounts have no definite relation to specific units of operation and there have accordingly been differences of opinion as to the proper method of treating such costs.

The second limitation arises from the difficulty in collecting data to be used as a basis for units of comparison. It is possible to determine approximately only the total of passenger miles, where passengers are carried at a flat rate irrespective of distance.

The car mile is adequately defined as the travel of a car one mile, yet weight, length and seating capacity will vary with different cars. The energy necessary to propel a car one mile will differ with the speed, grade and number of stops. When the car mile is used as a unit, moreover, the assumption is made that there is no greater effort required to move a loaded car than an empty car. In using car mile units, it is important to know whether such units are calculated on trip distances and include only the car miles during which service is being rendered, that is "revenue" car miles, or whether such units include the unproductive or "dead" car mileage developed in routing "no passengers" cars between car stations and the beginning of the route.[1] The accounting of trail car mileage is also important.[2]

The importance of the car hour, in the street railway industry is due to the fact that platform labor, constituting a large element of expense, varies closely with the car hour, and for this reason it was officially adopted as a standard unit at an early date.[3] Its limitations are similar to those of the car mile. It is usual, moreover, for car hours to be computed upon the basis of total platform time, including therein car hours corresponding to "dead" car mileage. The resulting ratio of car miles per car hour does not therefore give in all cases the actual average speed in miles per hour.

Similarly miles of single track may or may not include sidings, switches or passing track. Costs per mile of single track upon a

---

[1] See Car Mileage, Its Use, A. H. Ford — 1898 *Proceedings Street Railway Accountants Association of America*, page 26.

Car Mileage, H. C. Mackay, 1899 *Proceedings Street Railway Accountants' Association of America*, page 25.

Car Mileage and How to Arrive at it Easily, J. M. Smith — *1901 Proceedings Street Railway Accountants' Association of America*, page 17.

Detail Records, Their Use and Value, J. H. Neal — 1910 *Proceedings American Street and Interurban Railway Accountants' Association*, page 116.

[2] See Report of Committee on Car Miles and Car Hours — 1911 *Proceedings American Electric Railway Accountants' Association*, pages 90–98.

See Report of the Joint Committee on a Statistical Unit for Car Operation — 1912 *Proceedings American Electric Railway Transportation and Traffic Association*, pages 132–140.

[3] Report of Committee on a Standard Unit of Comparison — 1901 *Proceedings Street Railway Accountants' Association of America*, page 142. This report which was adopted at the annual meeting in 1901 is here given in full. It appears, however, from later actions of the Accountants' Association that the sufficiency of the car hour as a statistical unit has not been generally accepted.

"WHEREAS, it has been shown conclusively that, in every case where the car hour unit has been given a fair trial by our members, it has demonstrated its practicability and great value, and has received their endorsement.

"THEREFORE, we recommend its adoption as a standard unit of comparison, and offer the following resolution:

"*Resolved*, that this Association recommends the adoption of the car hour as a standard unit of comparison."

double track route will have a different significance than costs per mile of single track where the track mileage is equivalent to the miles of line.

It must be concluded therefore, that the use of a single unit of comparison is not satisfactory in determining the costs of operation localized to any particular route, area or hour of service;[1] that the type of unit of comparison chosen must have some functional[2] relation to the item of revenues or cost analyzed; and that the unit must be chosen with a clear understanding as to its nature, advantages, limitations and the source data from which it is derived.

Before referring to the standard classification of accounts, and the steps which must be taken to rearrange items reported upon a departmental basis, into a grouping based on units of comparison, it will be desirable to examine into the reasons for the application of the units most frequently used.

Growth in the traction industry comes through the addition of small units of traffic to a fluctuating volume of business. To meet this growth, additional facilities are required from time to time. It is not possible, however, to maintain the plant at a size which will at all times just permit the carrying of the peak load or maximum demand. Equipment can not be disposed of with each decrease in business, nor added to within the hour to meet an unusual traffic movement. Economical sizes in generating equipment must be acquired and installed, not when their full capacity is required, but when any part of it is necessary. The result of these conditions is that there is in every wisely administered plant a certain reserve capacity. The rate of change in operating conditions determines for each traction plant the percentage of capacity it is wise to hold in reserve, and whether this be great or little the encroachment upon it is not to be contemplated under normal conditions. When it is proposed to add to the service of a street railway in such a manner as to use the normal reserve capacity of the plant, it is incorrect to assume that the additional service is rendered at a cost not to exceed the additional expense necessary to handle it temporarily. Certain elements of cost are not increased with additions to service when such additions do not require increased plant. Interest on investment in track, for instance, does not increase with traffic density. It is not to be held, however, that the additional business is to be relieved from any charge for interest. Rather should the total interest charge be divided among all the units of service. The determination of total cost rather than added cost is the fundamental purpose of cost analysis.

---

[1] J. A. Emery — "Statistical Units Used in Analysis of Electric Railway Accounts" — 1913 *Proceedings American Electric Railway Accountants' Association*, page 158:

"There is no unit, however, which furnishes a completely satisfactory basis for comparison of all items of operating expense or even of all groups of items."

See also: Report of Committee on Determining the Proper Basis for Rates and Fares — 1911 *Proceedings American Electric Railway Association*, page 282.

[2] One variable (for example "cost") may be said to be a function of (have a functional relation to) another variable (for example "car hours") when a change in the latter follows a change in the former.

This principle is particularly important where questions of public regulation are determined upon the basis of cost, since the fallacy of the additional business basis, if carried to its logical conclusion, would result in large inequalities between individual patrons and classes of patrons.

The fixed expenses representing capacity may be expected to vary with such units as the mile of single track and the number of cars owned. Fixed expenses are those which will accrue in practically the same amounts, whether the property is operated or not. Variable expenses are those which vary to a greater or less degree with changes in the amount of service rendered, and may be expected to vary with such units as the car mile, the car hour and the number of passengers carried. Ad valorem taxes and interest are examples of the former, while platform wages illustrate the latter. As applied to the cost of carrying a passenger, total fixed costs may be expressed in passenger units and variable costs in passenger mile units.

The ratio of variable to fixed units indicates the degree to which capacity is used. The number of car miles per mile of single track represents the density of service, passenger miles per car mile, the density of traffic, population per mile of track, the density of tributary population, and number of passengers to population, the number of rides per inhabitant, or riding habit.

Various suggestions have been made from time to time with regard to separating the cost of service into two classes (*a*) expenditures fixed in their nature which may be expected to continue irrespective of the amount of traffic involved, or the length of haul, and (*b*) expenditures dependent upon traffic, and the application of such separated costs to a system of rates. Such a process has been employed in the determination of rates for electric, gas, telephone, water and railroad service, where such rates are based on cost.[1]

Whether, and to what extent, rates should be based on cost is not germane to the present discussion. Obviously, however, the total revenue which any scale of rates produces must be able to meet the total cost of the service rendered by the utility, and thus cost is

---

[1] Typical descriptions of such methods of analysis may be found in the following references: Electric:— John Hopkinson, Cost of Electric Supply, *Transactions, Junior Engineering Society*, England, 1892, III, pp. 1–14, Reprint in *Rate Research*, National Electric Light Association, II, pp. 23–28; Arthur Wright, Cost of Electricity Supply, 1896, Convention, Borough Electrical Engineers, Brighton, England, Reprint in *Rate Research*, II, pp. 359–365, 375–383; Wisconsin Railroad Commission, in re Menominee & Marinette Light & Traction Co., 3 W. R. C. R. 778, 822 ff.

Telephone:— Reports of D. C. & W. B. Jackson and Arthur Young & Co., on Cost of Telephone Service in Chicago, Dec. 30, 1908, and May 9, 1910, report of W. J. Hagenah, Investigation of Chicago Telephone Co., May 2, 1911.

Railroad:— Albert Fink, Analysis of Railroad Costs and Their Application to Rates — Annual Report of the Commission of Railroads and Telegraphs of the State of Ohio, 1884; 20th Report Association of American Railway Accounting Officers, 1905; Wisconsin Railroad Commission, Buell *vs.* C. M. & St. P. Railway Company, 1 W. R. C. R. 324; Thomas H. Woodlock, Ton Mile Cost, New York, 1909; Halford Erickson, Freight Rates, *Proceedings National Association of Railway Commissioners, 1910*; Railroad Commission of California in the matter of the Application of San Francisco, Napa & Calistoga Railway for authority to increase certain fares, 5 C. R. C. 441; Railroad Commission of Wisconson in the matter of switching charges in the Milwaukee Terminal District, 14 W. R. C. R, 261; Interstate Commerce Commission in the matter of the so-called Western Rate Advance Cases of 1915, 33 I. C. C. 497.

necessarily the basis of the revenue whether it be taken to be the determining factor in fixing the charge to individual patrons or to classes of patrons.

In determining charges for service to individuals and to several classes of patrons, the principal alternative theory to "cost of service" is "value of service". In recent years there appears to have been made much greater progress in the determination of the former than of the latter, and it is likely that still further advances in the science of cost analysis will follow the recent decision of Mr. Justice Hughes in the so-called North Dakota Coal Case.[1]

Rates consisting of a fixed charge per passenger plus a charge per passenger mile, are suggested by the Board of Public Utility Commissioners of the State of New Jersey.[2] A more extended

---

[1] The Legislature of North Dakota in 1907 fixed rates for the transportation of coal The carriers claimed that the statute was confiscatory. The state courts denied the carriers claims. The matter having been carried to the Supreme Court of the United States. Mr. Justice Hughes spoke in part as follows: (236 U. S. 585)

* * * "In determining the cost of the transportation of a particular commodity, all the outlays which pertain to it must be considered. We find no basis for distinguishing in this respect between so-called "out-of-pocket costs" or "actual" expenses, and other outlays which are none the less actually made because they are applicable to all traffic, instead of being exclusively incurred in the traffic in question. * * * It is not a sufficient reason for excluding such, or other, expenses to say that they would still have been incurred had the particular commodity not been transported.

"The state insists that the enactment of the statute may be justified as a 'declaration of public policy.' In substance the argument is that the rate was imposed to aid in the development of a local industry and thus to confer a benefit upon the people of the state. But, while local interests serve as a motive for enforcing reasonable rates, it would be a very different matter to say that the state may compel the carrier to maintain a rate upon a particular commodity that is less than reasonable, or — as might equally well be asserted — to carry gratuitously, in order to build up a local enterprise. It does not aid the argument to urge that the state may permit the carrier to make good its loss by charges for other transportation. We cannot reach the conclusion that the rate in question is to be supported upon the ground of public policy if, upon the facts found, it should be deemed to be less than reasonable."

[2] While the immediate introduction of a radical departure from the present system is not before the Board, we incline to believe that eventually the entire zone system, together with the flat five-cent fare, will have to be replaced by a more rational and equitable system of charges. The rational system would seem to be a uniform basic charge alike for all passengers, plus a charge varying roughly with the length of the actual ride. The justification, roughly speaking, for such a basis, is as follows:

Every passenger upon a trolley car requires from the motorman and conductor practically an identical service in having the car stopped twice and in having the fare collected. Every passenger also, irrespective of the length of his ride, benefits by the existence, maintenance and operation of certain parts of the transportation property, such as the electric plant with its supply of power. It would, therefore, appear that a uniform contribution or basic charge, might justly be collected from every adult passenger, irrespective of the length of his journey on the car. Over and above the uniform service rendered to every passenger, there is a service which roughly varies with the length of the ride which the passenger takes. There is more current generated and used, the longer the ride, as well as greater wear and tear upon the car and other apparatus. Both the cost to the company and the presumed benefit of the service to the passenger are greater, the longer the total ride enjoyed by the passenger. It would thus appear that a uniform basic rate or charge which permits, without additional charge, a ride of short but definite length might properly be accorded for a uniform basic fare, and that every mile or fraction thereof in excess should be paid for at a stipulated rate per mile. If, for example, the basic rate were five cents, and a rate per mile (in excess of a short ride of two miles) were set, for example, at a cent per mile, we should have a system of charges more equitable to the company and its patrons than the present haphazard plan. The present system depends on a sufficient number of short rides to offset the low mileage rates for those who traverse long distances. It is correlative of an arbitrary zone system which, with its sharp demarcations, creates a not altogether unfounded feeling of injustice on the part of those who are inconveniently situated as regards zone limits. Precisely what price should be charged for the basic part of the fare, and what rates per mile for the excess distance over the minimum ride covered by the basic fare are practical questions which experience must determine, but that economic necessity will eventually establish such a system seems as probable as it is necessary.

State of New Jersey Board of Public Utility Commissioners, in the matter of the application of the South Englewood Improvement Association *vs.* The New Jersey and Hudson River Railway; and Ferry Company, and the Public Service Railway Co., Dec. 11, 1911, pp. 5–6.

method of analysis is that outlined by the Railroad Commission of Wisconsin in the Milwaukee fare case.[1]

What are fixed and variable items and what unit or units of comparison will permit the most accurate cost analysis will be considered for the Standard Classification of Operating Accounts.

### I. Maintenance of Way and Structures.

Account No. I Superintendence.

This item appears to vary with the other expenditures classified in this group, although, due possibly to more expert knowledge required

---

[1] The calculation of what is a paying haul per revenue passenger used in the Commission's findings has proceeded along somewhat different lines. A division has been made between costs affected by the length of haul per passenger, as distinct from costs more or less fixed in their nature, which, since service is shaped to meet the public demand, must be assessed against each passenger irrespective of his haul. Borrowing a terminology current in railway transportation costs analyses, these classes may be respectively termed "movement" and "terminal" costs.

Assuming that traffic is temporarily at a standstill, certain expenses would doubtless continue. Among these are a portion of the cost of maintenance and repair of roadway and rolling stock, power plant costs varying with the demand, depreciation due to the action of the elements, and a portion of interest upon the investment. Such costs are dependent upon the size or location of the entire traction plant and are not affected by any possibility of increased traffic. Such expenditures have been grouped in our analyses as "terminal" costs.

Assuming a limited demand for service, certain additional costs are occasioned. Among these are wages of conductors and motormen, the output cost of power, and that portion of the maintenance and depreciation of roadway and rolling stock occasioned by travel and wear. Such costs are dependent upon the frequency of schedule, as expressed in car hours run, the necessary length of trip, as expressed in car miles run, and the total weight transported, as expressed in ton miles. A portion of such costs will vary with the number of passengers hauled. If there is no demand for service, the headway can be reduced or the route shortened. In its very nature, however, the traction business is somewhat inflexible and cannot adjust itself readily to meet momentary changes in the demand for service. It is necessary to run a car whether three or two dozen passengers are accommodated and it is necessary to complete a trip whether all passengers have reached their destination or not. Moreover, it is necessary to maintain a constant schedule in order that all patrons may know when service will again be available. It is obvious that the expenditures within this group will be partly fixed and partly variable and may hence be divided between "terminal" and "movement," dependent upon the traffic conditions upon each line. Assuming that all cars can be filled to a comfortable load at all times and for the entire trip, all of such costs would vary with the passenger miles and be classed in our analysis as movement costs. Due, however, to the variable demand for traction service such a condition is not possible. Facilities must be held in readiness to serve the demand for transportation at the morning, noon and evening peaks, while throughout the day cars are compelled to operate, and costs varying with the car hour, car mile and ton mile are continued at far less patronage than the full comfortable seating capacity will accommodate. To decrease the number of patrons served when facilities are furnished in compliance with a demand for a through trip and a constant headway, is to occasion a definite loss. When losses of a similar character occur in a competitive industry where the supply of input and outgo can be somewhat regulated by the management, such losses, or standby costs as they are called, will but remotely affect the price. In a public utility business, where the demand for service must be met and satisfied whenever and wherever occasioned, these standby losses are generally outside of the control of the management and are therefore properly to be considered a part of the cost of service. The ratio of the average carload to the comfortable load will, therefore, determine what portions of this class of expenditure are "movement" and what portions "terminal" costs.

Under any conditions of operation there are additional costs which undoubtedly vary with the number of passengers carried or density of traffic. Among these may be placed cost of injuries and damages and a certain part of the transportation expenses, notably the cost of car station employees, dispatchers, operation of the telephone system, and the cost of printing tickets and transfers. Such costs are affected entirely by the number of passengers hauled and would cease if traffic were at a standstill. This entire group of expenses will vary with the passenger miles and are grouped in our analysis as "movement" costs.

In addition to the above three groups there is a small additional portion of the total expenditures which cannot be definitely localized, such as administrative costs. Such overhead costs have been prorated in our analysis in the proportion that the direct movement and terminal costs bear to their total.

Wisconsin Railroad Commission Report — City of Milwaukee *vs.* T. M. E. R. & L. Co., 10 W. R. C. R., 1, 292–294.

under modern conditions of operation, this item has generally increased somewhat more rapidly than the other expenses of the way and structure group, to which it is closely related. It is a well-established principle of cost accounting that expense of supervision should be spread over the costs involved in the operations supervised,[1] and unless there is some reason for special treatment,[2] the item of superintendence will therefore be considered as a general charge to be spread prorāta over other expenditures in the group.

Accounts No. 2 Ballast.
3 Ties.
4 Rails.
5 Rail Fastenings and Joints.
6 Special Work.
17 Signal and Interlocking Apparatus.

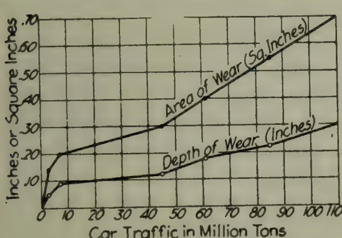
There will be found under each of the above accounts a varying percentage of costs not directly affected by changes in the amount of service rendered which may be prorated upon the basis of miles of single track. The determination of the percentage of maintenance costs that is independent of fluctuation in operating units, is an engineering problem, and the results will vary with different properties.[3] This part of the cost will include the maintenance due to weather

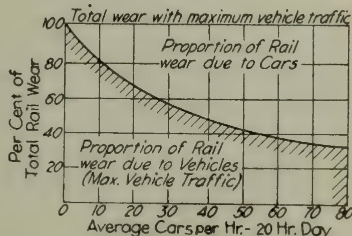
---

[1] Just what constitute the common or indirect expenses is not always easy to describe . . . In most industries, however, they include such items as the following: superintendents and foremen; certain clerical labor; power, heat and light; travelling expenses; indirect labor; telegraph and telephones; office expenses, stationery and printing; sundry materials and supplies; insurance; general expenses; repairs; depreciation on buildings, tools and machinery; taxes; interest on loans and on investments; and on other items of this nature. In by far the greater proportion of establishments the common, general or indirect expenses are distributed in proportion to either all or a part of the direct expenses."
Buell *vs.* Chicago, Milwaukee & St. Paul R. R. Co., 1 W. R. C. 394.
George Lisle — "Accounting in Theory and Practice," page 263:
"Indirect expenses are those which cannot be directly charged to a particular department or piece of work done. They are, as a rule, expenses . . . of general control and management. . . These expenses, so far as not directly chargeable to each job, are charged as a percentage on the wages or material, whichever may be the most suitable for the special circumstances of the business."

[2] As for example, Superintendence of Transportation.

[3] *Electric Railway Journal*, May 9, 1914 — Rail Wear Measurements on the United Railroads of San Francisco.




Board of Supervising Engineers, Chicago Traction, Sixth Annual Report — Year ended January 31, 1915, pp. 397.
"In order to determine to what degree this vehicular traffic is responsible for deterioration of the track structure, a large number of observations, by a micrometer instrument, were made at various points on the system, selected with reference to both car and vehicle traffic The results presented in the diagram indicate that, even with as heavy a trunk line as Cottage Grove Avenue (around 40 cars per hour average for a 20 hour day), the vehicle wear may amount to as much as half of the total wear on the rail head and thus reduces the life of the rail by a corresponding amount."

and that necessitated by street traffic. The maintenance due to cutting of ties in (3), and the attrition by car wheels in (4) are variable costs dependent upon traffic. Traffic measured in ton miles is theoretically more closely related to mechanical wear than traffic measured in car miles, but where the tonnage per car is not essentially different, car miles may serve as the proper unit of comparison.[2]

Accounts No. 7 Underground Construction.
10 Paving
11 Cleaning and Sanding Track.
12 Removal of Snow and Ice.
13 Tunnels and Subways.
14 Elevated Structures and Foundations.
15 Bridges, Trestles and Culverts.
16 Crossings, Fences and Signs.
18 Telephone and Telegraph Lines.
20 Poles and Fixtures.
21 Underground Conduits.
22 Distribution System.
23 Miscellaneous Electric Line Expenses.

These accounts cover expenditures which will occur practically independently of the extent of traffic. An increase in car miles, car hours, or number of passengers will obviously have little effect upon the cost of maintaining paving, for example, or upon the cost of maintaining tunnels and subways. These expenditures then may be classed as practically entirely fixed and apportioned upon the basis of miles of single track affected.

Accounts No. 8 Track and Roadway Labor.
9 Miscellaneous Track and Roadway Expenses.

The expenditures under these two accounts tend to vary with the expenditures chargeable under Accounts 2 to 6 inclusive, and may therefore be treated as an overhead addition to those accounts.

Account No. 19 Miscellaneous Way Expenses.

This account is maintained for the purpose of taking care of expenditures not properly chargeable under any of the other maintenance of way accounts and if the entries amount to any considerable sum they must be separately studied. Under ordinary circumstances this account will be so small that it can be spread over Accounts 2 to 18, inclusive, as an overhead addition.

Account No. 24 Buildings, Fixtures and Grounds.

Under previous classifications this account has included the cost

---

[2] See also: Experimental Determination of Stresses in Track — C. C. Williams — *Railway Age Gazette*, July 16, 1915.
Measuring Stresses in Railway Roadbeds — *Engineering News*, April 15, 1915.
Progress Report of Committee on Stresses in Railroad Track — *American Society of Civil Engineers*, 1914, *Bulletin American Railway Engineering Association Vol. 16–1915.*

of labor and material used in repairing and maintaining the buildings, fixtures and grounds of all departments of electric railway operation. At the present time, however, the maintenance of buildings devoted to power plant and substation purposes is charged under Account No. 46, and expenses incident to the maintenance of the buildings housing signal or interlocking apparatus are included under Account No. 17. It is advisable in the analysis of this Account No. 24 to separate the expenditures, insofar as possible, between those made in repairing the various classes of buildings. Car houses, shops and general offices will not have their maintenance costs affected appreciably by fluctuations in the volume of traffic, but stations and waiting rooms may require greater expenditures as business increases.

Accounts No. 26, 27 Other Operations.

These accounts are provided for the purpose of interdepartmental accounting by companies which operate other utilities, such as electric power, light or heat. If they contain relatively large amounts, the items which go to make up the total should be separated and reclassified under those of the preceding 25 accounts to which they are properly related.

Account No. 28 Equalization — Way and Structures.

This account, the use of which is optional, permits the spreading of seasonal charges uniformly throughout the year, and will not be found in statements covering a year's operations.

## II. Equipment.

Account No. 29 Superintendence of Equipment.

The superintendence of equipment is essentially similar to superintendence of way and structures and the comments made concerning that account are here applicable.

Accounts No. 30 Passenger and Combination Cars.
33 Electric Equipment of Cars.
34 Locomotives.
35 Miscellaneous Equipment.

Certain deterioration occurs in the case of cars which are not taken out of the station and the expenses occasioned by this deterioration are entirely independent of the volume of traffic, and may be expressed as cost per car. Certain other expenditures for maintenance of cars will vary with the number of passengers carried, while the largest part varies probably more directly with car miles.

Accounts No. 32 Service Equipment.
38 Vehicles and Horses.

The maintenance of service equipment is not closely related to any unit of operation, and can best be treated as a general overhead

expense to those accounts to which the expenses of clearing wrecks, cleaning streets and other maintenance operations affected, are charged.

Accounts No. 36 Shop Equipment.
37 Shop Expenses.
39 Miscellaneous Equipment Expenses.

These accounts represent expenditures incurred in the maintenance of rolling stock and its electric equipment (30), (32) and (33), and as such should be treated as a general overhead expense in connection with those accounts.

Accounts No. 42, 43 Other Operations.
44 Equalization — Equipment.

The comment on Accounts 26 to 28 applies to these as well.

### III. Power.

Account No. 45 Superintendence of Power.

Superintendence of power should be treated similarly to expenditures for superintendence under the preceding groups of accounts.

Account No. 46 Power Plant Buildings, Fixtures and Grounds.

This account includes expenditures for labor and material used in the repair of power plant and substation buildings and fixtures, and the cost of maintaining the grounds connected with such buildings. In general, this expenditure will not vary with the output of any particular plant, but is more closely related to the capacity of the power equipment. This and succeeding accounts must be separated as between fixed and variable cost, which may be prorated respectively, upon investment in power plant and the car mile.

Accounts No. 47 Power Plant Equipment.
48 Substation Equipment.
49 Transmission System.
52 Power Plant Employes.
53 Fuel for Power.
54 Water for Power.
55 Lubricants for Power.
57 Substation Employes.
58 Substation Supplies and Expenses.

The expenditures for the maintenance of power equipment are occasioned both by deterioration from natural causes and by deterioration through operation. It is necessary to determine for each account the part of the total cost which varies with operation and the part which does not. The expenditures for labor, fuel and miscellaneous items vary closely with the total output. Fixed or demand expenses may be prorated upon the basis of the maximum number of cars in service, and variable or output expenses upon the basis of car miles.

Where it is desired to compute the cost of service for various periods of the day it is necessary to take into account the character of the daily load upon the station and the amounts expended for fuel and labor in preparation for peak conditions of operation.

Account No. 51 Equalization — Power.

The treatment of this account is similar to that of Accounts 28 and 44.

Account No. 56 Miscellaneous Power Plant Supplies and Expenses.

The miscellaneous expenditures included under this account vary closely with the output. Under normal conditions, this account may be treated as an overhead expenditure to be distributed prorata among Accounts 52 to 55, inclusive.

Accounts No. 59 Power Purchased.
60, 61 Power Exchanged.

An effort should be made to estimate, with as great a degree of accuracy as possible, the demand and output elements of the rate at which power is purchased or the cost of producing an equivalent amount of power. The cost may be related to cars and car miles in a manner similar to that outlined for preceding accounts.

Account No. 62 Other Operations Cr.

The charges under this account should be treated similarly to Accounts 27 and 43.

## IV. Conducting Transportation

Account No. 63 Superintendence of Transportation.

It has been previously pointed out that expenditures for supervision tend to vary with expenditures in the departments over which the supervision is exercised, but that the item of superintendence probably tends to increase somewhat more rapidly than do the other expenditures in the various groups. In the case of superintendence of transportation, an exception may well be made to the first part of this general rule, inasmuch as it appears upon examination that the expenditures under this head vary more closely with the number of passengers handled than with the other expenditures in the general group. For further discussion see Technical Notes, page 100.

As the density of traffic increases and as problems of schedules and routing become more complex, it is necessary to assign the problems to assistants for more detailed study. It is apparent also that as the size of the system increases, the supervision of traffic becomes of greater importance. For these and other reasons it appears that superintendence of transportation has tended, in the past, to keep pace with the growth in the number of passengers rather than with other expenditures under this general group of accounts.

It should also be borne in mind that certain of the expenditures in connection with operation, such as car house labor, car housing expenses, operation of signal and interlocking apparatus, etc., receive a considerable amount of supervision from the mechanical departments. Car cleaning and inspection is frequently supervised by the individuals who supervise car maintenance and repairs and the operation of signals is frequently under the jurisdiction of the engineer in charge of these installations.

Account No. 64 Passenger Conductors, Motormen and Trainmen.

The wages of conductors and motormen tend to vary more closely with the car hours than with any other unit of operation. Where, however, there is a guaranteed minimum wage, it will frequently be found that the cost of platform labor per car hour is from 20 to 30 per cent greater during the rush hours than at other times of the day. This is due, of course, to the fact that certain of the platform men are receiving pay for more hours than they actually spend in operating cars. Such a fixed element of cost may be expected to vary with the number of cars in service rather than with the car hour.

Accounts No. 66 Miscellaneous Car Service Employes.
67 Miscellaneous Car Service Expenses.

The expenditures under these accounts usually show wide variation. A considerable portion of the expenditures, such as the wages of switch tenders, flagmen, or watchmen, is practically independent of the extent of operation and should be treated as a general expense, while other expenses, as for lubricants and waste, supplies for heating, lighting, or cleaning, tend to vary rather closely with car mileage. The cost of employes' badges, uniforms, signs, etc., is fixed and will vary with the number of cars in service at the time of the maximum demand.

Accounts No. 68 Station Employes.
69 Station Expenses.

The expenditures under these accounts will be partly fixed, varying with the number of cars owned and partly variable, depending upon the number of passengers handled.

Accounts No. 70 Car House Employes.
71 Car House Expenses.

These expenditures tend to vary with the number of cars handled.

Accounts No. 72 Operation of Signal and Interlocking Apparatus.
73 Operation of Telephone and Telegraph Lines.

The expenditures chargeable to these accounts do not appear to vary with the traffic and should be treated as a general expense burden.

Account No. 78 Other Transportation Expenses.

The miscellaneous expenditures charged under this account will consist, for urban properties, largely of costs incurred in the removal of wrecks and the replacement of derailed cars, together with the wages of the crews of emergency vehicles. The car mile unit seems to measure most accurately the probability of the occurrence of the events which make necessary the expenditures properly chargeable under this account.

### V. Traffic.

Accounts No. 79 Superintendence and Solicitation.
80 Advertising.
81 Parks, Resorts and Attractions.
82 Miscellaneous Traffic Expenses.

All of the expenditures under this general head are for the purpose of stimulating passenger traffic and it may be properly considered that these expenses vary with the number of passengers. In any comparison, however, of the profitableness of individual lines, there should be ascertained the amount of traffic moving to and from amusement parks and other attractions, and the cost of such departments together with the proportional part of the expenditures for superintendence under this general group of accounts should be charged to the particular lines on which the expenditure has stimulated the traffic.

### VI. General and Miscellaneous.

Accounts No. 83 Salaries and Expenses of General Officers.
84 Salaries and Expenses of General Office Clerks.
85 General Office Supplies and Expenses.
86 Law Expenses.
87 Relief Department Expenses.
88 Pensions and Gratuities.
89 Miscellaneous General Expenses.
90 Valuation Expenses.
93 Insurance.
94 Stationery and Printing.
95 Store Expenses.
96 Garage and Stable Expenses.

The larger portion of the expenditures chargeable under these accounts relates to the general administration of the property and is a fixed expense. A part, however, deals with the details of operation, as the handling of accounts, printing, and stores of the various operating departments, and will tend to vary in large part with the volume of traffic. These expenditures, if not particularly allotted to specific units, may be prorated to the preceding expenses as an overhead percentage to each group.

Account No. 92 Injuries and Damages.

A classification of expenditures chargeable to this account, indicating the amounts paid to passengers, to employes and to others, and the type of accident suffered, will assist in determining the unit of operation to which the total expenditure for injury and damage claims is most closely related. From an examination of such statistics as prepared by several companies, it appears that personal injury claims tend to vary most closely with the number of passengers carried.

Account No. 97 Rent of Tracks and Facilities.

This account provides for the payment of rentals for the use of tracks and facilities jointly with the lessor company. The rent of leased facilities which are no longer operated by the lessor company is treated as a deduction from income and is not here considered. The basis of the contract under which the right of use of facilities is acquired should govern to some extent the method and the treatment of this account. Where the basis of charge is car mileage, number of cars, or any similar basis, the unit should be taken from the terms of the contract. If, however, the lease prescribes a flat rental of so much per month or per year, then such expenditure must be treated as a fixed expense, similar in nature to interest or taxes.

Account No. 98 Rent of Equipment.

Expenditures for the rent of equipment, if the lessee bears the cost of maintenance, may be based upon car miles. If, however, the lessor maintains, then the expenditures charged under this account may be analyzed in the light of the distribution of the rental of the lessor between interest, taxes and maintenance. Usually the expenditures for the rent of equipment may be treated satisfactorily by the use of either the car mile or car basis.

Accounts No. 99, 100 Other Operations.

The treatment of these accounts should be similar to that of Accounts 26 and 27.

## VII. Transportation for Investment, Cr.

This account is provided to permit the proper charging to investment of expenditures made by operating departments for new construction and for additions and betterments. The items here shown result from interdepartmental accounting, and the total of this account should be broken up to correspond with the expenditures as originally made and as previously charged to certain of the preceding one hundred accounts. In order that operating expenses may bear their proper relation to operating revenues, the total credit under this account should be replaced by corresponding credits to each of the previous one hundred accounts.

Accounts No. 25 Depreciation of Way and Structures.
40 Depreciation of Equipment.
41 Equipment Retired.
50 Depreciation of Power Plant Buildings and Equipment.

These accounts are provided for the purpose of equalizing maintenance charges over a period of years. Amounts currently charged here are credited to reserve funds from which are drawn from time to time the amounts necessary to replace parts of the physical property which can not be economically retained in service by ordinary maintenance. It is difficult to draw any definite line between expenditures chargeable to depreciation and expenditures chargeable to maintenance,[1] but such a distinction is here unnecessary as it must be assumed that the basis of the charges to the above accounts has been worked out in advance of the making of the charges. From the standpoint of the study of costs the charges rather than the credits to the depreciation reserve are pertinent. The amounts shown under the four accounts, 25, 40, 41, and 50 should therefore be analyzed in the light of the plan adopted by the management in setting them up, which plan will of course represent the expected disbursement of the reserve. In the tables following, the percentages shown are based on an average investment in the several types of depreciable property and the estimated average life of each.

From the preceding brief discussion of the expenses entering into the cost of operation, it is apparent that careful analysis is necessary in order to determine the functional relation between expenditures and operating units.

Many of the primary accounts contain both fixed and variable expenses, and the proportion of each in the case of any account depends obviously to a considerable extent upon the density of traffic and upon the character of the construction of the physical plant.

In the following table there is given a typical apportionment schedule for a street railway plant such as may be found in American cities of from 100,000 to 1,000,000 population. The percentages shown in this table are approximate. They may be expected to differ with each company. The fixed expenses indicated in the first table have been combined with taxes and return upon the investment, and these expenses have been classified into those dependent upon miles of track, cars, the capacity of generating and transmission equipment, and the general plant. The solutions of some of the special problems, depending upon such an analysis of cost, are treated in Chapters XIV to XX. These problems indicate conditions under which it is necessary to make further analyses, and these are there taken up in detail.

---

Halford Erickson, Chairman Railroad Commission of Wisconsin. Depreciation — Address delivered before the Convention of Cedtral Water Works Association, Detroit, Mich., Sept. 25, 1912, pages, 6, 9.

## TECHNICAL NOTES

### STATISTICAL METHOD OF DETERMINING THE FUNCTIONAL RELATION BETWEEN UNITS OF COMPARISON AND ITEMS OF OPERATING COST

(1) *Data.* The operating expense in question may be tabulated by months for a number of years, care being used to safeguard against any differences in accounting practice, which might invalidate the use of these costs for purposes of comparison. Similar tabulations may be made of the units of comparison with which the expense item may be expected to vary, such as car miles, car hours, passengers, miles of single track, etc.

(2) *Problem.* It is desired to determine the unit of comparison whose variation conforms most closely to the variation of the item of expense, in order that the unit cost determined by dividing the expense by the unit of comparison may be used as the basis of prorating costs over various lines, areas, or hours of operation.

(3) *Method — Correction of Original Data for Seasonal and Annual Variation.* Due to the fact that both units of comparison and operating expenses may be expected to vary during the various months of a single year on account of seasonal changes, it is desirable to reduce each monthly item to the monthly average for the twelve preceding months. Similar "moving" or "floating averages," as they are frequently called, may be employed for longer periods where items of expense are involved which do not occur uniformly year by year, but recur at periods of several years. Maintenance expense items frequently have such characteristics.

(4) *Method — Determining Proper Unit of Comparison by Inspection.* The original data as corrected for seasonal and annual variation may be directly compared by computing the percentage increase or decrease over the preceding year, and the unit chosen which most closely conforms to the variation of the total operating expense items.

(5) *Method — Graphical Determination of Functional Relation between Units of Comparison and Operating Expenses.* The original data corrected for seasonal and possible annual variation may be plotted on logarithmic paper, the horizontal or abscissa distances representing consecutive years to a uniform scale, and the vertical or ordinate line representing total cost or number of units plotted to the logarithmic scale. The following graph, Fig. 14, shows the relative increase of the expense item, "Superintendence of Transportation" compared with the increase in miles of single track, car miles, car hours and total passengers carried. It will be noted that the slope of the item of expense conforms most closely to that of the number of passengers carried. In other words, where the number of passengers carried is the unit or divisor of "Superintendence of Transportation" expense, the resulting unit cost for various years will be more constant than where such item of expense is compared upon the basis of car miles, car hours or miles of single track.

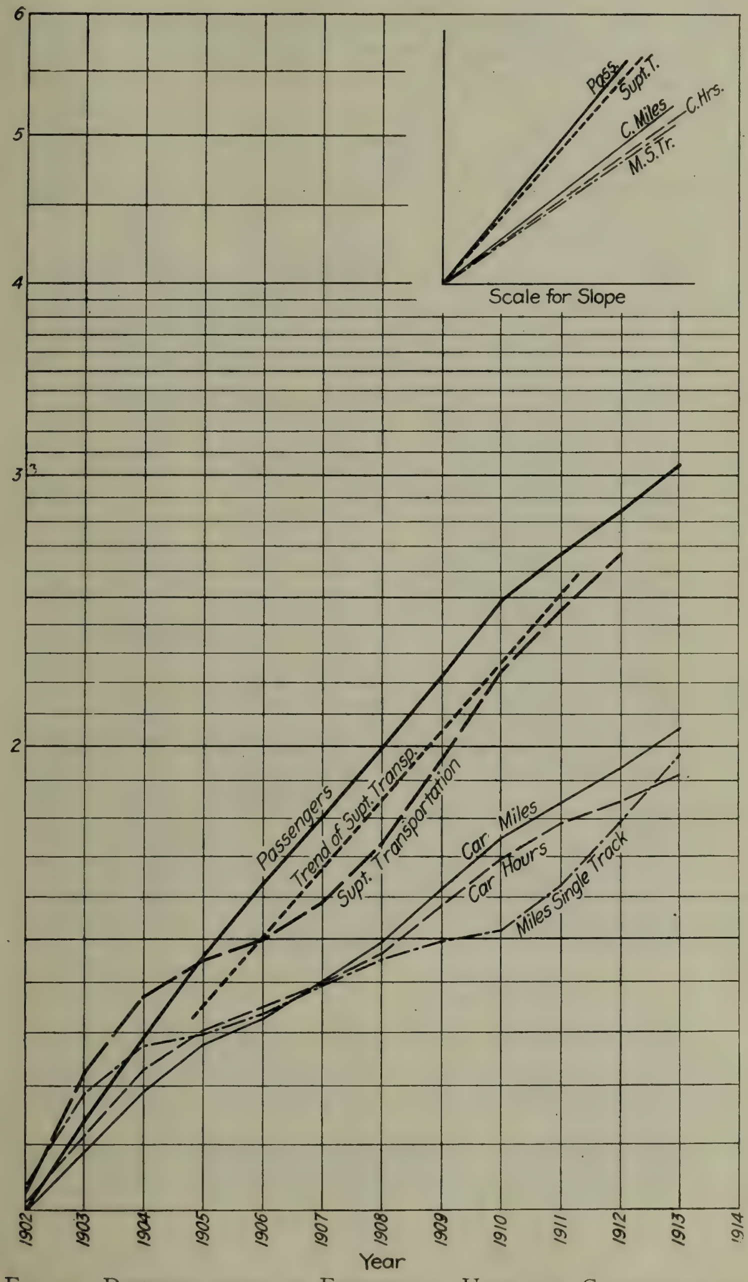



FIG. 14. DETERMINATION OF FUNCTIONAL UNIT FOR COMPARISON OF COST OF SUPERINTENDENCE OF TRANSPORTATION.

Table XXII. Summary of Separation of Operating Expenses by Accounts into "Fixed Expenses" and "Variable Expenses."

| No. of acct. | Account | Fixed | | Variable | |
|---|---|---|---|---|---|
| | | Per cent | Unit | Per cent | Unit |
| | **Way and Structures** | | | | |
| 1 | Superintendence. . . . . . . . . . . . . | Overhead to accounts 2–25, inclusive | | | |
| 2 | Ballast. . . . . . . . . . . . . . . . . . . . . | 85 | Miles of track. . . | 15 | Car miles |
| 3 | Ties. . . . . . . . . . . . . . . . . . . . . . . | 75 | Miles of track. . . | 25 | Car miles |
| 4 | Rails. . . . . . . . . . . . . . . . . . . . . . | 10 | Miles of track. . . | 90 | Car miles |
| 5 | Rail fastenings and joints. . . . . | 10 | Miles of track. . . | 90 | Car miles |
| 6 | Special work. . . . . . . . . . . . . . . . | 10 | Miles of track. . . | 90 | Car miles |
| 7 | Underground construction. . . . . | 100 | Miles of track. . . | . . . . | . . . . . . . . . . . . . . |
| 8 | Track and roadway labor. . . . . | Overhead to accounts 2–6, inclusive | | | |
| 9 | Miscellaneous track and roadway expenses. . . . . . . . . . . . . . | Overhead to accounts 2–12, inclusive | | | |
| 10 | Paving. . . . . . . . . . . . . . . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 11 | Cleaning and sanding track. . . . | 100 | Miles of track. . . | . . . . | |
| 12 | Removal of snow and ice. . . . . . | 100 | Miles of track. . . | . . . . | |
| 13 | Tunnels and subways. . . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 14 | Elevated structures and foundations. . . . . . . . . . . . . . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 15 | Bridges, trestles and culverts. . | 100 | Miles of track. . . | . . . . | |
| 16 | Crossings, fences and signs. . . . | 100 | Miles of track. . . | . . . . | |
| 17 | Signal and interlocking apparatus. . . . . . . . . . . . . . . . . . . . . . | 75 | Miles of track. . . | 25 | Car miles |
| 18 | Telephone and telegraph lines. . | 100 | Miles of track. . . | . . . . | |
| 19 | Miscellaneous way expenses. . . | Overhead to accounts 2–18, inclusive | | | |
| 20 | Poles and fixtures. . . . . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 21 | Underground conduits. . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 22 | Distribution system. . . . . . . . . . | 100 | Miles of track. . . | . . . . | |
| 23 | Misc. electric line expenses. . . . | Overhead to accounts 20–22, inclusive | | | |
| 24 | Buildings, fixtures and grounds. | 60 | . . . . . . . . . . . . . . | 40 | |
| | (*a*) Way. . . . . . . . . . . . . . . . . . | 60 | Miles of track. . . | 40 | Car miles |
| | (*b*) Equipment. . . . . . . . . . . . | 60 | No. cars owned. . | 40 | Car miles |
| | (*c*) General. . . . . . . . . . . . . . . | 60 | General overhead and administrative expenses. . . | 40 | No. passengers |
| 25 | Depreciation of way and structures: | | | | |
| | (*a*) Roadway, track and distribution. . . . . . . . . . . . . . . . . | 75 | Miles of track. . . | 25 | Car miles |
| | (*b*) Buildings, fixtures and grounds. . . . . . . . . . . . . . . . . | 75 | Miles of track. . . | 25 | Car miles |
| | (*c*) Miscellaneous property. . | 75 | Miles of track. . . | 25 | Car miles |
| 26–27 | Other operations — Dr. . . . . . . . | See discussion page 93 | | | |
| | Other operations — Cr. . . . . . . . | See discussion page 93 | | | |
| | **Equipment** | | | | |
| 29 | Superintendence. . . . . . . . . . . . . | Overhead to accounts 30–40, inclusive | | | |
| 30 | Passenger and combination cars | 25 | No. cars owned | 75 { 75<br>25 | Car mile<br>No. pass |
| 31 | Freight, express and mail cars. . | 25 | No. cars owned. . . | 75 | Car mile |
| 32 | Service equipment. . . . . . . . . . . . | Overhead to accounts 2–12, inclusive | | | |
| 33 | Electric equipment of cars. . . . | 10 | No. cars owned. . . | 90 | Car mile |
| 36 | Shop equipment. . . . . . . . . . . . . | Overhead to accounts 30, 32, 33 | | | |
| 37 | Shop expenses. . . . . . . . . . . . . . . | Overhead to accounts 30, 32, 33 | | | |
| 38 | Vehicles and horses. . . . . . . . . . . | Overhead to accounts 2–12, inclusive | | | |
| 39 | Misc. equipment expenses. . . . . | Overhead to accounts 30, 32, 33 | | | |

TABLE XXII — (*Continued*)

| No. of acct. | Account | Fixed Per cent | Fixed Unit | Variable Per cent | Variable Unit |
|---|---|---|---|---|---|
| 40 | Depreciation of equipment | | | | |
| 41 | Equipment retired | | | | |
| | (*a*) Revenue cars and car equipment | 25 | No. cars owned | 75 | Rev. car miles |
| | (*b*) Service cars and car equipment | 25 | No. cars owned | 75 | Serv. car miles |
| 42 | Other operations — Dr | See discussion page 94. | | | |
| 43 | Other operations — Cr | See discussion page 94. | | | |
| | **Power** | | | | |
| 45 | Superintendence | Overhead to accounts 46–58, inclusive | | | |
| 46 | Power plant, buildings, fixtures and grounds | 75 | Investment in power plant equipment | 25 | Car miles |
| 47 | Power plant equipment | 25 | Investment in power plant equipment | 75 | Car miles |
| 48 | Substation equipment | 25 | Investment in power plant equipment | 75 | Car miles |
| 49 | Transmission system | 100 | Investment in power plant equipment | .. | |
| 50 | Depreciation | | | | |
| | (*a*) Buildings | 75 | Investment in power plant equipment | 25 | Car miles |
| | (*b*) Equipment | 25 | Investment in power plant equipment | 75 | Car miles |
| | (*c*) Miscellaneous property | 25 | Investment in power plant equipment | 75 | Car miles |
| 52 | Power plant employes | .... | ............... | 100 | Adjusted output[1] |
| 53 | Fuel for power | .... | ............... | 100 | |
| 54 | Water for power | .... | ............... | 100 | |
| 55 | Lubricants for power | .... | ............... | 100 | |
| 56 | Miscellaneous power plant supplies and expenses | Overhead to accounts 52–55, inclusive | | | |
| 57 | Substation employes | .... | ............... | 100 | Adjusted output[15] |
| 58 | Substation supplies and expenses | .... | ............... | 100 | |
| 59 | Power purchased | | | | |
| 60 | Power exchanged — balance | See discussion page 95. | | | |
| 61 | Power transferred — Credit | | | | |
| 62 | Other operations — Cr | See discussion page 95. | | | |
| | **Conducting Transportation** | | | | |
| 63 | Superintendence | .... | ............... | 100 | No. passengers |
| 64 | Passenger conductors, motormen and trainmen | .... | ............... | 100 | Car hour |
| 66 | Misc. car service employes | 50 | No. cars owned | 50 | Car mile |
| 67 | Misc. car service expenses | .... | ............... | 50<br>50 | Car mile<br>Car hour |
| 68 | Station employes | 75 | No. cars owned | 25 | No. passengers |

[1] Output (car mile or kw-hr.) unit costs should be adjusted to take account of standby costs.

Table XXII — (*Concluded*)

| No. of acct. | Account | Fixed | | Variable | |
|---|---|---|---|---|---|
| | | Per cent | Unit | Per cent | Unit |
| 69 | Station expenses | 75 | No. cars owned | 25 | No. passengers |
| 70 | Carhouse employes | 10 | No. cars owned | 100 | No. cars handled |
| 71 | Carhouse expenses | | | 90 | No. cars handled |
| 72 | Operation of signal and interlocking apparatus | 100 | General overhead expense | | |
| 73 | Operation of telegraph and telephone lines | | | | |
| 78 | Other transportation expenses | .... | ................ | 100 | Car mile |
| | **Traffic** | | | | |
| 79 | Superintendence and solicitation | Overhead to accounts 80–82, inclusive | | | |
| 80 | Advertising | .... | ................ | 100 | No. passengers |
| 81 | Parks, resorts and attractions | .... | ................ | 100 | No. passengers |
| 82 | Miscellaneous traffic expenses | .... | ................ | 100 | No. passengers |
| | **General and Miscellaneous** | | | | |
| 83 | Salaries and expenses of general officers | 100 | General overhead and administrative expense | .... | |
| 84 | Salaries and expenses of general office clerks | 40 | General overhead and administrative expense | 60 | No. passengers |
| 85 | General office supplies and expenses | 50 | General overhead and administrative expense | 50 | No. passengers |
| 86 | Law expenses | 100 | General overhead and administrative expense | .... | |
| 87 | Relief department expenses | 100 | General overhead and administrative expense | .... | |
| 88 | Pensions and gratuities | 100 | General overhead and administrative expense | .... | |
| 89 | Miscellaneous general expenses | 100 | General overhead and administrative expense | .... | |
| 90 | Valuation expenses | 100 | General overhead and administrative expense | .... | |
| 92 | Injuries and damages | .... | ................ | 100 | No. passengers |
| 93 | Insurance | 100 | General overhead and administrative expense | .... | |
| 94 | Stationery and printing | 50 | General overhead and administrative expense | 50 | No. passengers |
| 95 | Store expenses | 100 | General overhead and administrative expense | .... | |
| 96 | Garage and stable expenses | 100 | General overhead and administrative expense | ...... | |
| 97 | Rent of tracks and facilities | 100 | See discussion page 98 | | |
| 98 | Rent of equipment | .... | ................ | 100 | Car mile |
| 99 | Other operations — Dr | .... | See discussion page 98 | | |
| 100 | Other operations — Cr | .... | See discussion page 98 | | |

Table XXIII — Summary of Table XXII

| Unit | Groups of expenses | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Way and structures | Equipment | Power | Cond. trans. | Traffic | Gen. and misc. | Total | |
| **A. Variable Operating Expenses** | | | | | | | | |
| Car miles | 4.7 | 11.1 | 3.1 | 0.7 | .... | .... | 19.6 | Includes ton mile costs. |
| Car hours | .... | .... | .... | 0.5 | .... | .... | 0.5 | |
| No. of passengers | .... | 0.6 | .... | 1.9 | .... | 2.6 | 5.1 | Includes passenger mile costs. |
| Cars handled | .... | .... | .... | 4.0 | .... | .... | 4.0 | Each run necessitates two car handlings. |
| Platform labor | .... | .... | .... | 28.4 | .... | .... | 28.4 | Weighted for higher costs per hour on short runs. |
| Power output | .... | .... | 12.5 | .... | .... | .... | 12.5 | Weighted for higher unit costs at certain periods. |
| Sub-total | 4.7 | 11.7 | 15.6 | 35.5 | .... | 2.6 | 70.1 | |
| **B. Fixed Operating Expenses** | | | | | | | | |
| Other operating expenses | 12.1 | 5.2 | 2.6 | 0.7 | 0.4 | 8.9 | 29.9 | These expenses classified in Table III. |
| Total operating expenses | 16.8 | 16.9 | 18.2 | 36.2 | 0.4 | 11.5 | 100.0 | |

Table XXIV — Fixed Expenses

| ITEM | [1] Operating expenses including depreciation | Taxes and return on investment |
|---|---|---|
| | Per cent | Per cent |
| Miles of track | 45.0 | 55.0 |
| Number of cars owned | 15.0 | 20.0 |
| Investment in power equipment | 10.0 | 15.0 |
| General overhead and administrative expense | 30.0 | 10.0 |
| Total | 100.0 | 100.0 |

[1] Fixed only, representing about 30% of total operating expenses.

TABLE XXV — FUNCTIONAL INCOME ACCOUNT

| ITEM | Income account based on percentages shown in Tables II and III |
|---|---|
| Operating revenue | $2,000,000 |
| Operating expenses (including replacement insurance) | 1,300,000 |
| Variable operating cost varying with: | 909,000 |
| Car miles | 254,600 |
| Car hours | 7,200 |
| Number of passengers | 65,400 |
| Passenger (80%) | 52,320 |
| Passenger mile (20%) | 13,080 |
| Cars handled | 51,000 |
| Platform labor | 369,000 |
| Car hours (90%) | 332,100 |
| Layover and guarantee (no. of runs) (10%) | 36,900 |
| Power | 161,800 |
| Car miles (85%) | 137,530 |
| Standby costs (15%) | 24,270 |
| Fixed operating cost based on: | 391,000 |
| Miles of track | 176,400 |
| Number of cars owned | 58,200 |
| Power capacity | 38,200 |
| General overhead and administrative expense (43%) | 118,200 |
| Net operating revenues | 700,000 |
| Fixed charge (taxes and return on investment) based on: | 700,000 |
| Miles of track | 390,600 |
| Number of cars owned | 137,600 |
| Investment in power equipment | 103,000 |
| General and administrative property (10.9%) | 68,800 |

## PART III

## ELEMENTS OF SERVICE

# CHAPTER VIII

## TRAFFIC CHARACTERISTICS

Peculiarities of the Public Demand for Service,—— Typical Traffic Characteristics,—— Use of Models,—— Statistical Measurement of Traffic Variation, Concentration and Diversity,—— Effect of Variation on Loading,—— Difficulty of Estimating Service Required,—— Seat Miles and Passenger Miles,—— Controlling Factors in the Plan of Study to be Adopted.

The cost of urban passenger transportation service and the extent of service rendered are closely interrelated. Traffic characteristics are the controlling factors of the cost of carrying a passenger and conversely the adequacy of earnings must be an important if not a controlling factor in the traction company's policy with respect to providing transportation facilities. The extent of this interrelation has not been generally appreciated. It is the purpose of this and the three following chapters to discuss the relation of studies of traffic characteristics to service and to discuss in Chapters XIV to XX the relation of service and traffic characteristics to the cost of passenger transportation service.

With the limitations of earnings, the objective point of every transportation official is to provide the maximum amount of accommodation for passengers. Traffic studies are an important means to this end. It is only by a full knowledge of the riding habits of its patrons that an electric railway can furnish this maximum service. The day has passed, for the majority of companies when any individual, by his personal observation can have sufficient knowledge of the demands for service at each point along the line to enable him to allocate service where it will serve the best purpose.

As will be evident from the study of typical traffic characteristics, traction companies supply on an average greater accommodations than the traffic will warrant. In a typical 24-hour period more seats are supplied than there are passengers demanding transportation. The occurrence of some of this superfluous transportation is due to the physical impossibility of creating such facilities immediately and where such facilities are called for and the necessity of maintaining a regular headway and of completing a trip to its destination irrespective of the number of patrons accommodated. Some superfluous transportation at certain points and times with deficiencies at other points and other times is due to misplaced service. The development of the modern traffic study has taken place in order to secure information of the traffic demand in such detail and with such accuracy as will give the necessary information for the construction of time tables properly adjusting the service to the traffic.

In the following chapter it is proposed to give some idea as to

the necessity and results of typical studies, when such studies may be undertaken with profit, and how they should be carried out.

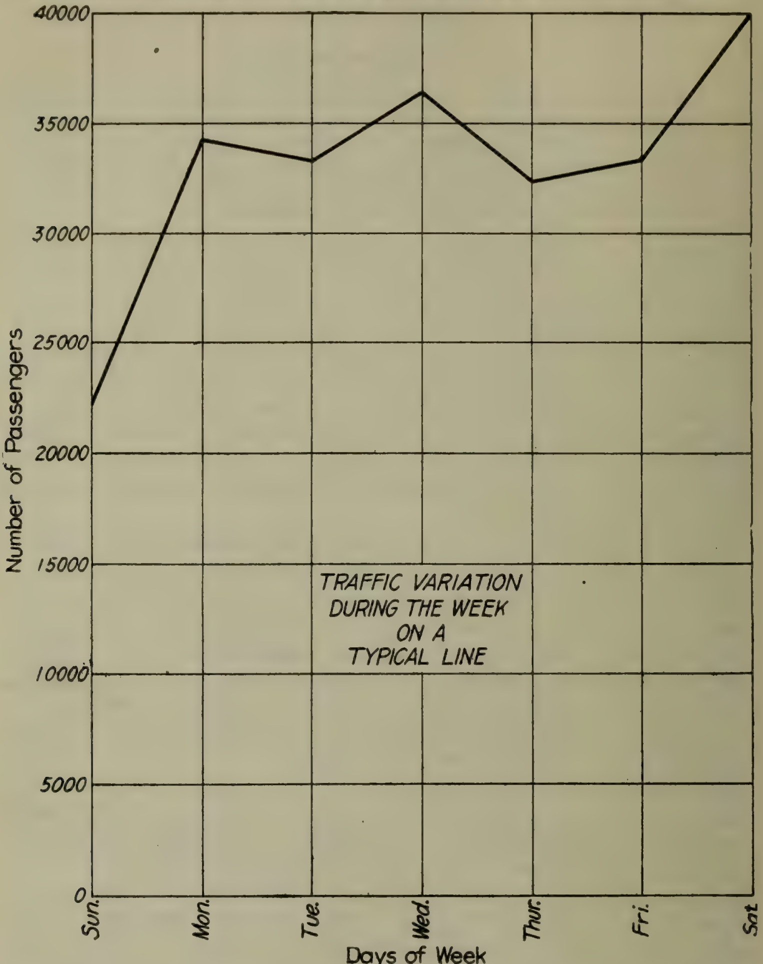



FIG. 15. CHART SHOWING VARIATIONS OF TRAFFIC FROM DAY TO DAY THROUGHOUT THE WEEK ON A TYPICAL LINE.

It is not many years since operating men first felt the need of a more accurate knowledge of the distribution of traffic over their lines and throughout the day, than their general knowledge gave them, and from a still more recent period dates the development of systematic and scientific traffic counts.

With the growth in magnitude and complexity of urban transporta-

tion, there has come about a less personal relation between the operating officer and the employes and patrons of his company.

With the increased cost of labor and materials, and the increased quantity and quality of service given for an unvarying fare there has resulted a decreased margin of profit.

With the growth in numbers and powers of regulatory bodies there has arisen a more intensive study on the part of the public of the service rendered by public utilities.

Development along these three lines has rendered necessary in recent years, for many companies, traffic studies that in the earlier stages of the industry would have been an extravagance. And today, however great the necessity for such studies, they still remain an extravagance — in the sense that all inefficiency is extravagant — if they fail to provide the maximum amount of useful information for a minimum expenditure.

In the last few years many studies have been made by consulting engineers, public commissions and operating officers. It is of interest to examine rather briefly the methods employed and the results obtained, and to see what, if any, progress has been made toward the development of a simple standard method of procedure.

In general, two purposes are to be served by obtaining traffic data. The first is to enable the company to fit its car miles to the passenger miles of its patrons in such a way as to minimize costs in so far as is consistent with the comfort of passengers and the development of new business.[1] The second purpose is one that exists because of the necessity of meeting complaints preferred in good faith, and arising from observations of varying accuracy, or preferred from an ulterior motive, and made the basis of an attack against the company before a body of great power which if not in possession of the truth may impose severe penalties.

In so far as the revenues of a company and its track capacity will permit, the comfort of patrons will be cared for, but it is not always obvious just where and when the car miles that are at the disposal

---

[1] The following abstract of a decision rendered January 28, 1915, by the Georgia Railroad Commission, in re: Application by Georgia Railway & Power Company, illustrates a well-defined tendency on the part of the regulatory bodies to take into account conditions as a factor which must be considered in regulation. P. U. R. 1915 A., page 901:

"A street railway company, upon showing a large decrease in its revenues, owing to a general business depression, is entitled to relief from expense of all service in excess of the reasonable needs of the public.

"The Commission, in investigating the question whether a street railway company is supplying excessive service, will not proceed upon the theory that a decrease in the use of all the lines of the system, as a whole, justifies less service on any individual line, but will ascertain service conditions, facilities, and uses on each individual route, and will pass upon each without reference to other routes of the system.

"Curtailment of expenses necessitated by decrease in travel, and consequent falling off of revenues of a street railway, owing to a general business depression, should not necessarily be made by taking off cars operated during 'rush hours,' since widespread business depression affects travel for pleasure, and on Sundays and holidays more than it does travel necessary for persons to get to their work or places of business.

"Adequate urban street railway service does not mean that every passenger on every car operated should be furnished a seat, but that the company should provide reasonable seating accommodations in its cars for such patrons as desire them, in so far as it can reasonably anticipate and measure the volume of traffic to be taken care of."

of an officer are most needed, and it is to meet this condition that traffic studies are necessary.

In planning a traffic study, there are three characteristics of the demand for service that must be considered and which are entirely independent of the personal element which enters into the judgment of individuals as to the quality of service rendered. They are

(*a*) The seasonal and daily variation in the riding habit of the community.

(*b*) The concentration of riding within certain hours of the day.

(*c*) The variation in the number of passengers wishing to ride on consecutive cars operating at an undistorted headway.

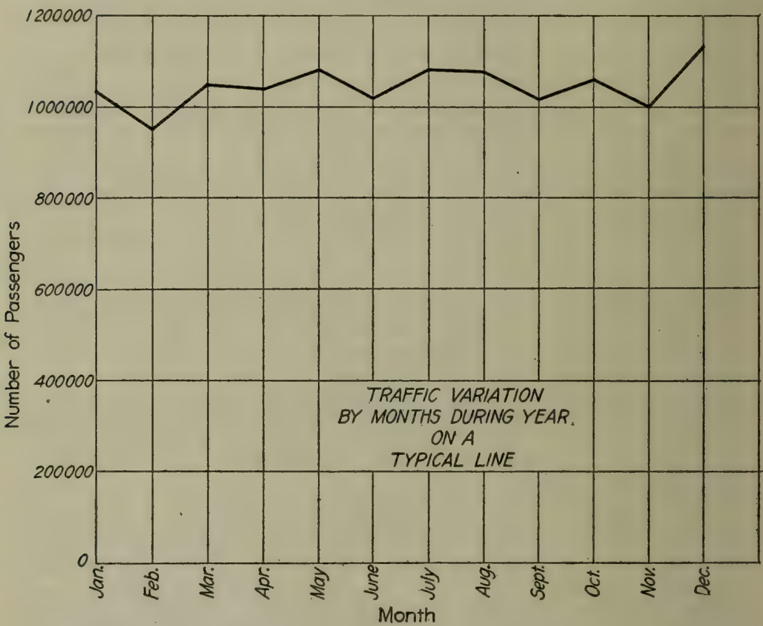



FIG. 16. CHART SHOWING FLUCTUATIONS, FROM MONTH TO MONTH, IN TRAFFIC ON A TYPICAL LINE.

The exceptionally heavy loading of the first car to pass after an unusual delay is expressly eliminated from consideration and there is in mind only the fact that due to causes entirely beyond the control of any company, cars passing at regular intervals of time will not be carrying the same number of passengers.

The first two characteristics of traffic demand combine to bring about regularly recurring peak loads, and their effect can be foretold with considerable accuracy. The third is largely accidental in its nature, but while the number of passengers wishing to ride on each car cannot be estimated beforehand with great precision, it is

still possible to reach a fairly accurate knowledge of the diversity of loading on the cars passing a given point in any 15 or 30-minute period.

The figures shown illustrate the peculiarities of traffic demand previously referred to:

Fig. 15 shows how traffic on a typical line varied from day to day throughout a week. It would be of interest to speculate on the reasons for the fluctuations from Monday to Friday, and for the fifteen per cent increase in traffic on Saturday. Does this figure represent conditions fairly well maintained throughout the year, or were unusual conditions encountered at the time these data were taken? Does the Saturday increase represent travel to parks, to ball games, or to steam and interurban electric railway stations, or does it represent evening riding to places of amusement? Does it offer any suggestions as to means of increasing traffic, and particularly traffic at times when the company's equipment is not now in use? These and many other questions it is within the province of the traffic survey department to answer.

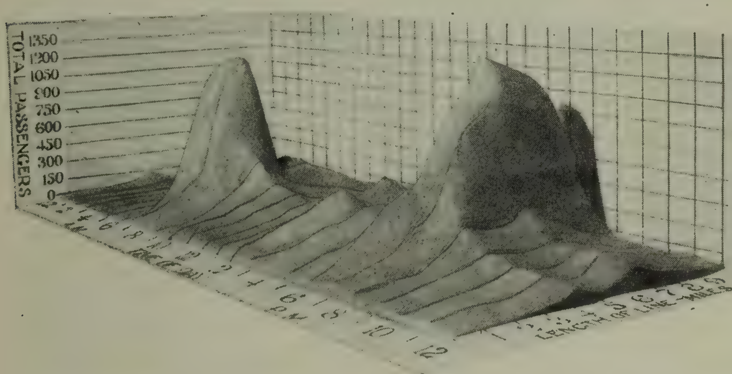



FIG. 17. MODEL SHOWING THE RELATION AT ALL POINTS ON A TYPICAL LINE BETWEEN THE NUMBER OF PASSENGERS AND THE TIME OF DAY.

Fig. 16 represents fluctuations of traffic from month to month and will suggest inquiries of value to any company. Is the seasonal variation in riding due to weather conditions, a situation indicating a considerable competition with other means of transportation? Does hot weather, cold weather, or rainy weather induce the greatest amount of riding, and does this indicate competition with automobiles as well as with walking? Does the summer increase result from ball games, or public parks and beaches and in what proportion? The traffic survey department should not only prepare data on which to base schedules, but should, as well, assist the officers of the company in the solution of the problems arising from an attempt to encourage such traffic as can be handled at a profit.

Fig. 17 is a photograph of a model constructed to show the relation between the number of passengers and the time of day, for each point of a typical line.[1] The hourly variation in traffic is clearly indicated by the height to which the model rises above its base, and the accuracy of the use of the term "peak" in connection with traffic is demonstrated.

Fig. 18 is a photograph of a model constructed to show the variation in car loading from point to point on a typical line and indicates that since the seating capacity of each car is fifty persons, there is being run a large number of idle seat miles, necessitated by the requirements of maximum headway and by the fact that cars cannot be put into service and taken out of service at every point on the line at the will of the operating department. These four figures are introduced primarily as illustrating conditions which the schedule maker must know, and while comment has been made on the value of knowing the causes of the traffic fluctuations there indicated, the primary concern is with the organization and methods best adapted to the collection of such data as are the basis of these figures.

The extent to which traffic tends to concentrate itself in certain hours of the day has an important bearing on the cost of passenger transportation service and this *concentration* is measured by a number which may be called the "concentration index of traffic." Defined, the concentration index of traffic is a number which when multiplied by the number of passengers carried in 24 hours gives the number which would be carried if rush-hour traffic continued uniformly throughout the day.

To illustrate, a certain company carried 5 500 passengers on one line in 24 hours and of these, 500 were handled between 5 and 6 p. m. Had this rush-hour traffic existed throughout the 24 hours, 12 000 passengers would have been carried. The concentration index of traffic for this line then is 2.18 for 2.18 x 5 500 (the number actually carried) is 12 000 (the number which would have been carried if rush-hour traffic had existed throughout the 24 hours).

The extent to which traffic tends to vary from car to car presents one of the great difficulties encountered in the attempt to render high grade service and this *diversity* is measured by a number representing

---

[1] The method of construction of these models may be of interest.

On a sheet of cross-section paper there was first laid off a horizontal line representing to scale the distance between points where traffic observations were made on a typical line.

Ordinates were next erected at each point of observation representing to scale "total passengers" or "passengers per car" observed at that point. The plotted ordinates represent "hourly rates;" that is to say, where the total number of passengers passing a point of observation was, say 200 from 3:30 to 4:00 p. m., and 300 from 4:00 to 4:30 p. m., the ordinate erected at that point of observation would be drawn to represent 500 passengers per hour.

The next step was to connect the ends of the ordinates by a curve. The cross-section paper was then pasted to a sheet of cardboard and cut along the base line and the curve connecting the tops of the ordinates. This process was repeated for each of the 24 hour periods of a typical day. Values used in this work were averages determined from observations extending over a period of three days.

The cardboard curves were next arranged in order, in notches sawed in the board which forms the base of the model. The position of these cardboard strips is shown by the dark lines traversing the figures. Between the strips a plastic material was placed and each of the 24 prisms was smoothed off to conform with the trend indicated by the adjoining prisms. The resulting surface was finally painted and varnished.

the relation of the largest number of passengers on any one car to the average number on all cars passing a given point in a definite period of time.[1]

For example, the five cars passing a certain point during 15 min. contained respectively 21, 42, 43, 40 and 25 passengers, the average number being 34. The relation of the maximum 43 to the average 34 is 126 per cent, this being then the measure of the diversity of loading.

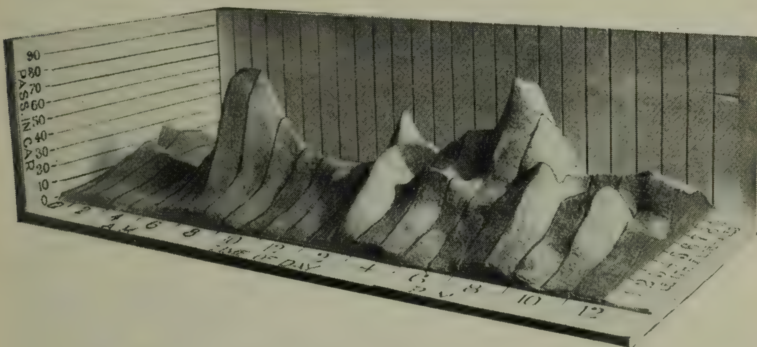


FIG. 18. MODEL SHOWING THE VARIATION ON A TYPICAL LINE, OF CAR LOADING AT VARIOUS POINTS. AS THE SEATING CAPACITY OF EACH CAR IS 50, THE MODEL INDICATES A LARGE NUMBER OF IDLE SEAT MILES, NECESSITATED BY REQUIREMENTS FOR MAXIMUM HEADWAY AND THE IMPOSSIBILITY OF TAKING CARS OUT OF SERVICE AT POINTS WHERE THE NECESSITY CEASES.

Information concerning car loadings was recently obtained from six companies operating in various parts of the United States. The loading data covered ten lines in each city and the results are the averages obtained from three day observations made on each of the 60 lines. From these figures the diversity factor for each line during the morning and the evening rush was computed. In the following summary, taken from an unpublished report, there is shown separately for the two rush periods by companies, the maximum diversity factor for any one line, the minimum diversity factor for any one line, and the average of the ten diversity factors as found for the ten different lines.

It will be noted that the average diversity factor is greater during the p. m. rush than during the a. m. rush. This is attributed to the fact that the passenger demand is more uniformly distributed during the morning rush. It will be seen, from the above summary, that the minimum diversity factor for each company is greater during the a. m. rush than during the p. m. rush. This again shows a better distribution and more uniform loading during the a. m. rush period.

[1] Unusual distortion of headway arising from a block of *any sort* will produce a large diversity of loading and should be eliminated from consideration.

The tabulation below would tend to show that the greater the demand the greater the diversity.

Tabulations of this sort showing the variation in traffic characteristics, by hours and by lines, can be made quickly and easily from data taken in traffic surveys, and will well repay careful study.

Summary — Diversity Factor

| | | Minimum | Maximum | Average |
|---|---|---|---|---|
| Company No. 1 | A. M. rush | 131 | 148 | 137 |
| | P. M rush | 105 | 182 | 142 |
| Company No. 2 | A. M. rush | 104 | 139 | 120 |
| | P. M. rush | 100 | 141 | 121 |
| Company No. 3 | A. M. rush | 110 | 150 | 126 |
| | P. M. rush | 107 | 200 | 135 |
| Company No. 4 | A. M. rush | 106 | 136 | 123 |
| | P. M. rush | 105 | 148 | 123 |
| Company No. 5 | A. M. rush | 122 | 153 | 137 |
| | P. M. rush | 117 | 158 | 138 |
| Company No. 6 | A. M. rush | 100 | 136 | 117 |
| | P. M. rush | 105 | 156 | 123 |

Eliminating from consideration those accidental variations in service which even the most carefully and conscientiously operated lines occasionally meet, and those unfortunate traits of human nature that at times lead individuals into exaggeration which amounts to misrepresentation, it will be found that the peculiarities of traffic demand which must be known and met to insure good service are those already defined, viz.: "concentration" and "diversity."

On the majority of lines, during the rush hour, there are two points fairly well defined which it is also of importance to determine. They are the point at which the maximum load is first obtained, and the point at which the loading becomes appreciably less than the maximum. Between these points occur such conditions of loading as cause complaints and beyond the second occurs excess car mileage if at all, the elimination of which is the constant effort of the management.

Particularly during the non-rush hours the lack of uniformity of the flow of traffic into and out of cars may cause a considerable variation in the number of passengers in cars moving at a uniform headway the result of which is that certain passengers may be obliged to stand. A knowledge of this non-rush-hour variation in loading or "diversity" will assist in determining the excess of seats over passengers which it is necessary to provide under normal conditions to furnish seats for all, at a time of day when a company can best demonstrate to the public that it is acting in good faith in its attempt to serve the convenience and comfort of its patrons.

Too often, however, in the past franchise requirements and commission rules and regulations have overlooked the fact that the number of seats in a car is fixed and that it is impossible to put into service

and remove from service at every point on a line cars to meet the service requirements imposed. In order that the fare paid may purchase the maximum amount of service, which is equally desired by the operator and the patron, consideration must be given to two phases of diversity of loading:

(*a*) Passengers without seats.
(*b*) Seats without passengers.

In order to furnish ten passengers with seats for a mile trip, it may be necessary to run a car with seats for forty passengers five miles. The 200 seat miles furnished for ten passenger miles may impose a burden on the service that is not to the best interest of the patrons as a whole.

An interesting example of the difficulties and dangers arising from an effort to fit car operation, which is inelastic because the smallest unit of service that can be rendered is the seat miles of a round trip of one car, to an inelastic standard of service, has recently come to notice.

The diversity of loading observed on a certain line was such that it was believed that the furnishing of 33 per cent more seats would insure no standing except by preference. At the time the original survey was made, the company was furnishing during each 15-minute period, a seat per passenger at the point of maximum loading, but due to the diversity of loading some cars had vacant seats and others had standing passengers. Under the circumstances, 4.2 per cent of the passenger miles were being made by passengers who could not find seats. After increasing the service (seat miles) by one-third, it was found that 3.8 per cent of the passenger miles were made by standing passengers. Thus to increase by 0.4 of 1 per cent the number of miles made by seated passengers, it was necessary to increase the seat miles furnished by 33 per cent.

Diversity indicates a vacant seat for every standing passenger on a schedule providing a seat per passenger and while a passenger may stand for one block only, the vacant seat is carried through to the end of the run. Diversity in loading is accidental and to provide completely against such abnormality in the flow of traffic, is usually so expensive as to impose a serious burden upon the traffic as a whole. While, therefore, it may be impossible to take care of all diversity in loading, it is nevertheless important that this diversity should be known and that the attendant circumstance of vacant seats should be shown in connection therewith.

Up to a certain point, additional service can be furnished at certain times of the day and in certain localities at a reasonable cost and where this is possible, it should of course be done, but it should be constantly borne in mind that the figures to be considered are not seats and passengers but *seat miles* and *passenger miles*. This point

should be especially emphasized, and although there are attendant difficulties due to the fact that the charge for urban transportation is very generally not based on the length of ride, such data as can be obtained should be used to measure service not by the ratio of seats to passengers at any point but by the ratio of seat miles to passenger miles within a given district and during a definite period of time. This last ratio measures the relation between what the passenger wants and what the company provides. It should be possible to determine then the diversity of loading and the points between which maximum loading exists, from the data taken in any traffic study, in addition to the information usually determined as to the number of passengers passing points of heaviest traffic at different hours of the day.

In 1909 for a period of 24 hours a count was made of every passenger entering and leaving every car of one of the largest companies, at every point on the line. Frequent observations have been made by many companies of the number of passengers passing some point of heavy loading during thirty minutes or an hour in the evening rush. Between these two studies lies the practical mean, and bearing in mind that the simpler the plan the more frequently the observations can be made, the question involves the determination of the point, for each of the following items, where increased expenditure is not accompanied by data of sufficiently greater value to justify the outlay.

(*a*) Type of man and organization to be employed on the work.
(*b*) Frequency of collection of data.
(*c*) Extent of data to be taken.

These features of traffic studies will be discussed in the following chapters dealing with the organization to be employed, and the extent and frequency of data to be taken.

# CHAPTER IX

## THE TRAFFIC SURVEY

Function of the Organization,—— Field work,—— Office work, —— Supervision,—— Type of organization,—— Purpose of survey.

Although the development of extensive traffic studies has been relatively recent, various companies in order to judge of operating efficiency have for many years prepared certain traffic statistics. At first such data were usually taken from conductors' trip reports and confined to the determination of the number of passengers carried throughout the day and to the number of cars provided for their accommodation, with particular reference to the occurrence of heavy loads and the profitable use of trippers. The figures so obtained were variously plotted and analyzed.

A description of a method used in 1901 on the New Orleans & Carrollton Railroad, where it was introduced by George H. Davis, former manager of the road, now of the firm of Ford, Bacon & Davis, is given in the *Street Railway Review* of September 15, 1901, in an article by A. H. Ford, now general manager of the Cumberland County Power and Light Co.

Since that time, due to the constantly decreasing margin of profit in the traction industry and the increasing complexities of operation under urban conditions, necessity for greater and greater detail has arisen and to meet this, more extensive traffic studies have been made.

No attempt will be made here to pass on the value of these traffic studies, but it will be worth while to examine later the details of some of them as showing what practice has been and is.

It is well agreed that the type of man and organization to be employed in a traffic survey is of vital importance to its success and in the following paragraphs, especial attention will be paid to the details of organization.

The function of the traffic survey organization is the collection and compilation of information concerning traffic characteristics which it is necessary for the officers in charge of operation to have in order that the maximum operating efficiency may be reached. That organization is best which permits the collection of the maximum amount of pertinent and reliable data at a minimum cost.

There are three distinct classes of work in making traffic surveys:

(*a*) The collection of data by observations in the field.

(*b*) The compilation and tabulation of field data in the office.

(*c*) The supervision of this work (*a* and *b*) and the study of results.

Based on these studies is the construction of time-tables, and it would be of advantage in many cases to place the working out of schedules under the man who directs and supervises the making of

traffic studies, and who analyzes their results. When this is done, there should be added a fourth division of the work.

(*d*) Construction of time-tables.

Before discussing further the general features of the organization and the supervision of the work, it will be well to examine both the purpose and the nature of the work to be done in the field and in the office.

The extent of the data required and the frequency of its collection present problems which will be given more extended attention later. Here it is pertinent to note that the field data to be recorded will consist of such items as the number of passengers boarding or leaving a car at certain points, the number of seated passengers on the car, the number standing, the time at which the car passes certain points, the condition of street traffic, the type of passenger, classified as to occupation, and other similar information. All items must be neatly and accurately recorded and turned in to the office in such shape as to facilitate their combination with other similar records taken by other observers.

Although there is substantial agreement as to the duties of observers, there is some disagreement among traffic experts as to who these field men should be; conductors on regular duty, conductors especially assigned to the work, or inspectors and special agents drawn from other departments or not previously connected with the company.

The 1910 Report of the Committee on Construction of Schedules and Time-Tables of the American Street and Interurban Railway Transportation and Traffic Association shows[1] that out of 38 companies reporting on the matter, 24 used inspectors; 12, conductors and 2, special agents. In the discussion that followed this report, it was brought out (3 to 1) that conductors' reports were uniformly unreliable and that inspectors' were far more efficient.

If it could be done without sacrificing efficiency, it would be economical to have observations made and data recorded by the conductor on duty with each car. Experience with this method of procedure has been, however, generally unsatisfactory in city operation. Bion J. Arnold, in his survey of the situation in San Francisco made in 1912, reached the conclusion that a traffic study based on conductors' reports is unreliable.[2]

---

1 1910 *Proceedings American Street and Interurban Railway Transportation and Traffic Association*, page 256a.

2 Report on Transportation Facilities, City of San Francisco, March, 1913, page 115.

"To make sure of results, as many as five observers were stationed on the non-prepayment cars. These counts showed the following missed fares or passengers missed by the conductor on a single trip:

1 line was 90 passengers short,
4 lines were 50 passengers short,
8 lines were 25 passengers short,
13 lines were 10 passengers short.

In one case, during a typical rush hour period, 38 per cent of the total registration was missed on a single car trip. In comparison therewith, only two prepayment lines showed 10 passengers or over missed by the conductor, the average being four or five, and in these two cases, the excessive crowding on the rear platform (against the company rules) prevented the conductor from reaching the passengers clinging to the rear step."

It might be noted that conditions of interurban operation permit conductors to devote more time to recording traffic statistics than those prevailing on city lines, and that results under these conditions are reliable.[1]

A. M. Taylor, Director of the Department of City Transit, Philadelphia, in reporting the Philadelphia Traffic Survey of November, 1912,[2] speaks of the great accuracy of the results as being due to the employment as checkers of experienced conductors borrowed for the purpose from the Philadelphia Rapid Transit Co. These conductors did not have charge of the cars but confined their attention to the collection of traffic data.

In 1909, Stone & Webster [3] in making a traffic count on the Metropolitan Street Railway lines in New York City resorted to the same expedient, namely, borrowed a number of experienced conductors from the Company and used them as checkers. However, it must be borne in mind that the purposes of both these studies and the extent of the data recorded were such that sufficient accuracy could be obtained only by men extremely familiar with local conditions.

Efficiency is developed by instructions as well as by experience and practice [4] and whether conductors undertake the work in addition to their regular duties or devote their whole time to recording traffic data, or whoever the field men may be, it is considered good practice to give the men taking the data thorough instructions in methods best calculated to insure accurate results; to provide them with bound pocket books ruled into columns and with proper headings, or printed cards on which to record all data; and to make frequent checks of their accuracy.[5]

The office force has as its duties, the assembling and analysis of the data collected by the observers and the preparation of information for use in constructing time tables. It may also be called upon to prepare special information of various sorts for various other

---

1 Howard F. Fritch, in *Electric Railway Journal*, September 21, 1912, comments as follows:

"Passenger counts are taken both by inspectors on the street and by conductors. The conductors take the count most frequently. Not only have very good results been obtained from counts taken in this manner but it is much more econominal, as a large force of inspectors would have to be employed to take counts over so large a territory as is covered by the Bay State Street Railway, while a large number of counts can be taken by the conductors at one time with practically no additional expense."

2 The Solution of a City's Transit Problem — *Electric Journal*, October, 1914, p. 518.

3 *Stone & Webster's Public Service*, March, 1913.

4 Speaking in general of the efficiency of inspectors, R. W. Harris, electrical engineer and traffic expert, says, in "A Method for Determining the Adequacy of an Electric Railway System" — 1910 *Proceedings American Institute of Electrical Engineers:*

"At first glance it might seem that the amount of data to be taken of each car going in one direction is more than could be expected without sacrificing accuracy, and especially when the time spacing of cars is often as short as ten seconds; this feature, however, is overcome by practice in making observations. As a matter of fact, the inspectors became so efficient that the data was found to be 95 per cent accurate by test which is sufficiently close for this class of work."

5 R. M. Feustel, formerly Chief Engineer, State Public Utilities Commission of Illinois, in reporting on the recent Winnipeg (Canada) traffic survey, says — Public Utilities Commission of Manitoba 1913 Report:

"Inspectors chosen were intelligent, accurate workers. The notes taken were entered into books in a form previously prepared and each man was provided with a watch, so that all records were accurately taken and uniformly listed. The inspectors were checked two or three times each day, both by a chief inspector and myself, to see that the notes were accurate, and each man was carefully instructed in the work."

departments. Questions of routing, transfers, extensions, time of loading under different conditions, effect of changing social and business conditions, etc., are subjects on which the traffic survey department may make reports and the office force should be recruited from those in other departments who have shown an aptitude in grasping the significance of figures. There will be drafting to be done but this will be largely the construction of curves and will not require great technical proficiency.

Whether the traffic survey is carried on as part of the work of the superintendent of transportation, and the work done by regular conductors and clerks from his office, or made a separate department whose director reports to the manager or superintendent of transportation, will of necessity depend many times on the size of the company and on the distribution of other duties among the officers and departments. It is of interest that the chief engineers of two state railroad commissions have recommended very strongly the establishment of separate and distinct organizations wherever possible for the collection and analysis of traffic data.[1]

In this connection, the *Electric Railway Journal,* April 25, 1914, reports the Pittsburgh Railways as having maintained for some years past a department of traffic statistics composed of divisions dealing with

(*a*) Routing and time-tables,
(*b*) Traffic counts,
(*c*) Dispatching.
(*d*) Publicity.

In outlining the transportation department of the Metropolitan Street Railway of New York, the *Electric Railway Journal* of June 25, 1910, states that a distinct time-table and statistical bureau is maintained in the department under the supervision of the superintendent of transportation. This bureau is under the immediate control

---

1 C. M. Larson, Chief Engineer of the Wisconsin Railroad Commission, in an article in *Municipal Engineering,* February, 1914:

"If the system is of considerable size a traffic study department should be established, either under the direction of the manager or the operating officer. If the system is small this officer may himself have direct charge of the details of the work provided he is thoroughly familiar with the nature and scope of the investigation to be made. This department should not be a spasmodic affair dependent for its existence upon a shortage of work in some other department. It should be permanent and should be prepared to supply to the manager or operating department reliable information on traffic conditions for any season, day or hour and upon any point of every line. In whatever way this is done (data collected) its collection should be under the direction of the head of the traffic study department in order that the results may be consistent and trustworthy."

E. Swenson, Chief Engineer of the Pennsylvania Railroad Commission, in Case No. 87 — 1910, Report on Pittsburg Railways Co.:

"Establish a central organization, which shall be in full control of securing all the data of the movement of population from and to the many centers of population, and all other traffic data in this territory. . . The personnel of this department shall be kept separate and distinct from that which takes care of the operatives and their interests. It should be composed of the following bureaus:
Traffic,
Routing and Scheduling,
Dispatching and Checking,
Publicity.
The first two and the fourth bureaus, the duties of which do not in any way pertain to the operatives, their time, etc., shall have a personnel composed solely of first-class technically trained men and that of the very best talent, as the *efficient* and *profitable* service depends largely upon their data and deductions."

of a chief who is aided in the work by a force of clerks and stenographers, tallymen and time-table makers.

Another article in the *Electric Railway Journal* of September 21, 1912, by Howard F. Fritch of the Bay State Street Railway, Time-table Department, describes that organization and its work. The department was originated in June, 1910, under Prof. A. S. Richey as superintendent of transportation and its duties are as follows:

1. To make investigations of traffic.
2. To keep graphical records.
3. To make time-tables for the entire system of 938 miles of track.

The preceding discussion of the organization of a department of traffic studies brings out certain general principles which have been deemed of value in the past and which it may be worth while to further emphasize and at the same time summarize.

As regards the type of man and organization to be employed on the work, it may be said that a separate, distinct, permanent traffic study department, under the sole and responsible direction of a first-class trained man with initiative and executive ability may well be established by many companies. The subordinates of this organization should be intelligent, accurate, well-instructed and properly aided and supervised men, and the personnel of the department should be kept separate and distinct from all others. While this would insure the maximum of efficiency and results which would be of the best in accuracy and completeness, it is manifestly not practicable in all cases and for the smaller companies would be out of the question. A simplified organization for these companies is to be desired and the following is recommended.

For present purposes, companies will be classified as large, medium, and small, but no attempt can be made to define any more closely the limits of these classes by reference to annual revenues, car miles, or other operating statistics. It may very well be that, because of peculiar conditions surrounding the operation of a property, it will be, for the purpose of this classification, in a group that it would not naturally fall in under classification on operating data.

It is recommended that large companies establish permanent departments for the purpose of traffic study under the superintendent of transportation, but directly in charge of a chief of a bureau of traffic statistics, who will devote his entire time to this work. Under him there should be two general classes of employes, inspectors or field men, and clerks and draftsmen, who will compile and analyze the data furnished by the inspectors, and prepare it for use in the construction of time-tables.

For companies of medium size, it is desirable that there be made regular and continuous studies under the direction of the superintendent of transportation and that there be used for the work, as inspectors, in addition to the employes regularly engaged in the supervision of loading, headways, schedules, etc., conductors and clerks

from the office of the superintendent of transportation who will be naturally in closer touch with such types of information as it is desired to compile, than men in other branches of the service. This information should be worked up by the regular office force of the superintendent of transportation.

In the small companies, only occasional studies will be made and these should be made under the direction of the manager by men from various offices and, in so far as the collection of data is concerned, by the older and more experienced conductors.

Regardless of the size of the company and the detail in which the information is desired, the purpose of the traffic studies will be to enable the company to reach two results: the first, that the maximum service which it is possible to render for the fare paid shall be given; and the second, that as great a saving as possible in car miles shall be made. The problem becomes that of making car miles coincide both as to time and place with passenger miles.

In the following chapter there will be taken up the matter of the extent and frequency of the collection of data necessary under different conditions.

# CHAPTER X

## TRAFFIC OBSERVATIONS

Frequency and Regularity of Collection of Data,—— Preliminary Work,—— Length of Period of Observation,—— Data to be Taken in Field,—— Field and Office Forms, ——, Analysis of Data, —— Summary.

The frequency and regularity with which traffic studies were made in the past varied considerably. In 1910 information from 24 companies indicated that 8 made such studies daily, 3 twice per week, 3 once or twice per month, 2 upon complaints and 8 at irregular and indefinite intervals. A report[1] made at that time suggests the following factors which may be said to control the frequency of such studies and the seasons at which they should be made:

(*a*) Size of the property.
(*b*) Character of the territory served.
(*c*) Rapidity of its growth.
(*d*) Density of traffic.
(*e*) Business conditions.
(*f*) Seasonal changes.

The report further points out that in order to secure full advantage of fluctuations in traffic and to anticipate public complaints the interval between such studies should be short. In this connection it is of interest to quote the two following paragraphs:

Passenger counts — That there should be periodical developments of records of passenger traffic with comparatively short intervals intervening.[2]

The Committee wishes to recommend that all member companies make daily records of passenger business by trains in interurban operation, feeling that such records are necessary statistics, not alone for proper construction of schedules and time-tables, but as well for the purpose of comparison with past results (the 1910 report shows 18 companies out of 57 making such a comparison) and as essential factors in developing estimates of future operation.[2]

Since traffic conditions vary not only with the seasons of the year but also with the days of the week,[3] many who have studied the matter believe that it pays to make a separate traffic study for week days, Saturdays and Sundays, since the termination of even a small part of the service and for a short time only may mean the saving of many car miles. Touching on this matter, C. M. Larson says:[4]

Such a record is necessary for week days, for Saturdays and for other seasons of the year when the traffic is not of the same magnitude. There are, of course, variations in traffic due to weather conditions. These can usually be determined by general observations and necessary steps taken for the required variation in the service.

---

[1] 1910 *Proceedings American Street and Interurban Railway Transportation and Traffic Association*, pages 256a and 264.
[2] 1911 *Proceedings American Electric Railway Transportation and Traffic Association*, page 506.
[3] See Fig. 15 and 16, Chapter VIII.
[4] " A Street Railway Traffic Survey " — *Municipal Engineering*, February, 1914.

In a paper presented March, 1914, before The Milwaukee Electric Railway and Light Company's Section of the American Electric Railway Association on "The Purposes of a Street Railway Traffic Survey," E. J. Archambault says:

The traffic count that is carried on in an extensive manner is generally taken during the late fall and winter months, because it is then that the peak loading is most pronounced and hardest to handle. Other checks, however, are constantly made at all times of the year. It is obvious that this is necessary since the demand is constantly on the increase as a rule, and also that changes are brought about by local conditions along various lines, which affect the loading of other lines as well.

It is interesting to note in this connection that the recent 1914 Detroit, as well as the 1910 and 1912 Philadelphia traffic surveys were made in the fall of the respective years. The Detroit survey was made by Barclay, Parsons & Klapp.[1] The first Philadelphia survey was made by Ford, Bacon & Davis;[2] the second by the Department of City Transit, Philadelphia, with that firm as consulting engineers. To quote from the report of the latter survey:[3]

The survey extended over a period of five weeks from October 14, 1912, to November 18, 1912, which period was selected as representing most nearly normal traffic conditions in Philadelphia.

Quite naturally the periods of heaviest riding throughout the year, the week and the day have received the greatest amount of attention, but if the traffic survey is to accomplish for any company all the good that it can, it should indicate plainly the relation existing at all times between the amount of transportation furnished and the amount required.

The extent of data to be collected in a street railway traffic study is variable, depending upon how comprehensively it is desired to analyze the transportation problem.

Most recent traffic studies consist of a systematic series of inspections and observations in which an actual passenger count is made and the movements of cars and passengers are recorded by inspectors or field agents stationed at selected pertinent points, or by riding on cars or both. In addition, other observations of a somewhat general nature are often made. These will be referred to later.

Traffic experts are pretty well agreed as to those points on each line of an electric railway system at which a passenger count should be made, and generally a preliminary survey is made to determine them, although occasionally they can be located by a rather casual inspection.

---

[1] Report of Barclay Parsons & Klapp on the Detroit Street Railway Traffic and Proposed Subway, January, 1915, page 57.

[2] Report of Ford, Bacon & Davis on the Philadelphia Service and Equipment — *Electric Railway Journal*, June 17, 1911, page 1065.

[3] A. M. Taylor, "The Solution of a City's Transit Problem" — *Electric Journal* October, 1914, page 516.

R. M. Feustel in his report on the recent (1913) Winnipeg traffic survey, gives the following account[1] of the preliminary work, and other recent studies, such as those in Milwaukee, Cincinnati, Philadelphia, etc., followed similar methods of procedure in laying out the work:

Inspectors were placed on every car on some lines, on every other car on other lines, and on every third car on the larger lines. They were kept on the car during the entire day, from the time the car left the car barn in the morning until late in the evening. Points were chosen along each line, approximately four blocks apart, and the inspector recorded the number of passengers on the car when passing these points and the time of passing. This data gave an accurate record of loading conditions on the different lines, both as to geographical location and as to time loading occurred. The observations taken covered at least two representative days of travel on each line, and if these two days checked satisfactorily one against the other, the data was considered sufficient. If, however, for any special reason the loading was eccentric, additional observations were taken until a normal record was had. An examination of data taken indicates that the travel throughout the day could be divided into rather characteristic periods. The record plotted shows the average of all the observations taken and each of the characteristic periods was plotted separately, into what might be called "car loading" curves. These plainly show the average load carried by the car for each period over the entire length of line. The points where total number of passengers on car were noted include all regular transfer points along line as well as the other important traffic stops. * * * From the car loading curves for each line the *point of maximum loading* was determined. Other points along the line were selected so that in most cases several street observations were taken on each line simultaneously. The inspectors who had become familiar with car loads were now stationed at these points to record cars and passengers.

The following special features were shown by these preliminary observations:

(*a*) Variations of traffic in both directions for the different periods of the day.

(*b*) Territory in which the pickup of passengers is made.

(*c*) Location of through territory in which comparatively few passengers are discharged or taken on.

(*d*) Location of unloading territory.

(*e*) Duration in time in which the overloading occurs.

(*f*) Effect of certain transfer points on car loading.

The following preliminary observations were made by Ford, Bacon & Davis in their 1910 study of Philadelphia Service and Equipment:[2]

1. Preliminary car riding by inspectors from July 12 to September 1, to determine:

(*a*) Characteristics of traffic.
(*b*) Principal time points.

---

[1] Report on the Winnipeg Street Railroad Service. Public Utilities Commission of Manitoba, 1913.
[2] Report of Ford, Bacon & Davis on Philadelphia Service and Equipment — *Electric Railway Journal*, June 17, 1911, page 1065.

2. Preliminary rush hour street observations between 4 p. m. and 7 p. m. from July 15 to August 26 to determine:

(*a*) The number of passengers carried past or away from each important point.

(*b*) Regularity of schedule.

(*c*) Car loading.

The practice followed by companies making studies with their own forces is generally less complicated than that indicated by the above references, and this has resulted from the fact that the former studies have usually been made for the purpose of answering specific questions as to conditions at definite points, while the latter have sought to obtain information concerning all lines and routes on the same basis. A report made in 1910 shows that out of 18 companies reporting, 11 use points of maximum load for observations. In addition, certain other points along the line are chosen in order to get roughly the general characteriistics of the line.[1]

Similar observations should be made at such other points along the line as may be determined by circumstances. The principal purpose of these latter observations would be to furnish a basis for turning of cars which it is not necessary to operate the entire length of the line.[2]

An extension of the above methods to cover every stop along a line may be found in the so-called "boarding and leaving" tabulation method, reported in use by the Boston Elevated Railway Co. and the Public Service Railway Co. of New Jersey [3] and used by Barclay Parsons and Klapp in the 1914 Detroit traffic survey.[4] It consists of having the checkers ride on a certain proportion of cars along a line and record the number of passengers getting on or off the car at every stop.

This method was also used by Ford, Bacon & Davis in their 1910 Philadelphia traffic study.[5] Observers were kept on one car in every eight along each line for 24 hours and recorded the number of passengers getting on or off the car at every stop, together with the time the car passed. The lines were counted by selected groups, related or adjacent lines being counted together and the count extended from August 29 to September 22, 1910. However, no observations were taken on Saturdays, Sundays or holidays.

Recent traffic studies, particularly those in Milwaukee, Cincinnati, St. Louis and Winnipeg have demonstrated that the point of maximum

---

[1] 1910 *Proceedings American Street and Interurban Railway Transportation and Traffic Association*, page 256a.

[2] A Street Railway Traffic Survey—C. M. Larson, *Municipal Engineering*, February, 1914.

[3] Recent Practice in Traffic Counts — D. J. McGrath, *Electric Railway Journal*, December 26, 1914, page 1385.

[4] Barclay Parsons & Klapp — Report on Detroit Street Railway Traffic and Proposed Subway, January, 1915, page 57. See also page 148.

"The work was divided into two classes:

"1. The continuous riding of lines from one terminus to another, recording the number of passengers loading and unloading at every street corner; the time from point to point; the number of passengers in the cars at various points; transfer conditions; and a few other special items peculiar to individual lines.

"2. Additional trips on all lines through the congested district. . . ."

[5] Report of Ford, Bacon & Davis on Philadelphia Service and Equipment — *Electric Railway Journal*, June 17, 1911, page 1065.

load is approximately the same for traffic in each direction, that is, for inbound cars in the morning and for outbound cars in the evening; that these points may be considered to follow roughly a line about the congested section; that between the point at which maximum loading first occurs and the point at which it ends, the number of passengers is approximately constant; and that there is a point on every line at which the company is justified in terminating part of its service, since few passengers live near the end of the line and the waste of car miles in order to make a turn is considerable.

The period of time the count on any line at any point should cover is fairly well agreed upon, considering the variation in local conditions to be met, and the divergent points of view of those having traffic studies in charge. A recent paper[1] comments thus:

> Unless special inspection is made for the rush hours only, the point of maximum loading is covered by an inspector at all times of the day from about 6 a. m. to about 12 at night. Frequently surveys are made which cover the complete 24 hours. This is done only where a question arises about the owl service.

and another:[2]

> The count should cover along enough period to obtain normal results with 24 hours as a minimum.

The reports of many of the recent traffic studies show that 24 hours was the minimum time spent at each point and in some cases observations at a point covered a period of several days.

A surface car traffic study in the Chicago business district, made in 1909 by the Bureau of Engineering of the Department of Public Works,[3] covered a 24-hour period. The same amount of time was then spent in a study of the elevated lines. In their Philadelphia (1910) general traffic survey, Ford, Bacon & Davis[4] used a 24-hour period as a minimum upon any one line. In the Winnipeg survey "from two to four days counts were taken on each line in order to obtain average results."[5]

Having determined the points of observation and the period over which data is to be taken, observers are stationed to collect the required data.

There is, as has been indicated, considerable divergence in practice between the items recorded in different surveys. This is due to varying local conditions, both as to the character of traffic and as to the purposes of the study, and to the organization of the traffic survey department. It is the usual, although not universal, practice to record all cars in each direction at all observation points along each line, the data for traffic in the two directions being preferably kept separately

---

[1] Purposes of a Street Railway Traffic Survey — E. J. Archambault, The Milwaukee Electric Railway & Light Co.

[2] A Street Railway Traffic Survey — C. M. Larson, *Municipal Engineering*, February, 1914.

[3] *Electric Railway Journal*, May 14, 1910, page 86.

[4] *Electric Railway Journal*, June 17, 1911, page 1065.

[5] R. M. Feustel, Report on the Winnipeg Street Railway Service — Manitoba Public Utilities Commission, 1913.

on the opposite pages of a notebook. It is standard practice on the Chicago Surface Lines to employ a note book ruled as follows:

Line........................................

At........................................................................ Weather........................................................................

| EAST | | NORTH | | WEST | | SOUTH | |
|---|---|---|---|---|---|---|---|
| Run number | Route | Time | Passengers | Run number | Route | Time | Passengers |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Checked by........................................................................

Remarks........................................................................

The New York Railways Co. uses "tally slips" (Form T-36) which are conveniently handled and from which figures for 15-min. periods are entered on form T-138 for report to the superintendent of transportation. Copies of these forms are given on pages 131 to 133.

The Milwaukee Electric Railway and Light Co. uses Forms 2226, 0000, and 2249 as shown on insert and page 133, for collecting and summarizing traffic data.

Form T-36 Standard $2\frac{1}{2}$x$7\frac{5}{8}$

..........Bound Slip No..........

..........Div.

..........Day..........191.....

Tallied at..........

| Time | Run | Car | No. of Pass. | | | Headway | Sign |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Name.......... Badge..........

Address..........

Form T-138 | Standard 7 15-16 x 10½

NEW YORK RAILWAYS COMPANY

Office of Superintendent of Transportation

Tally of.................................Cars. New York.................................day,................................191......

Bound.................................at................................. Bound.................................at.................................

Weather.................................Rail................................. Average seating capacity per car.................................

| Time | Cars | Seating capacity | Passengers | Excess or Shortage of Seat Capacity Per Car | | Cars required to give seats | Cars | Seating capacity | Passengers | Excess or Shortage of Seat Capacity Per Car | | Cars required to give seats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Excess | Shortage | | | | | Excess | Shortage | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

REMARKS

.................................................................................................

.................................................................................................

Copy to General Superintendent of Transportation. .................................

Copy to Division General Foreman. *Superintendent of Transportation.*

Date........................ Weather........................

Date........................ Weather........................

Date........................ Weather........................

Form 2249—7, 8, 14—500

The Milwaukee Electric Railway and Light Company

SUMMARY OF TRAFFIC CHECK

Standard 14x18½

Checked by........................ Day........ Line........................

Checked by........................ Day........ Place........................

Checked by........................ Day........ Direction........................

Checked by........................ Day........ From........ To........

| 15 min. period | Date | Actual Passengers | | | Actual Seats | | | Actual per cent load factor | | Allowed per cent load factor | Actual seats necessary | Number of cars arriving | | Car demand | Headway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | By days | Average 15 min. | Average 30 min. | By days | Average 15 min. | Average 30 min. | 15 min. | 30 min. | | | By days | Av. | | |
| 6.00 to 6.15 | | | | | | | | | | | | | | | |
| 6.15 to 6.30 | | | | | | | | | | | | | | | |
| 6.30 to 6.45 | | | | | | | | | | | | | | | |
| 6.45 to 7.00 | | | | | | | | | | | | | | | |
| 7.00 to 7.15 | | | | | | | | | | | | | | | |
| 7.15 to 7.30 | | | | | | | | | | | | | | | |
| 7.30 to 7.45 | | | | | | | | | | | | | | | |
| 7.45 to 8.00 | | | | | | | | | | | | | | | |
| 8.00 to 8.15 | | | | | | | | | | | | | | | |
| 8.15 to 8.30 | | | | | | | | | | | | | | | |
| 8.30 to 8.45 | | | | | | | | | | | | | | | |
| 8.45 to 9.00 | | | | | | | | | | | | | | | |
| 9.00 to 9.15 | | | | | | | | | | | | | | | |
| 9.15 to 9.30 | | | | | | | | | | | | | | | |

| 15 min. period | Date | Actual Passengers | | | Actual Seats | | | Actual per cent load factor | | Allowed per cent load factor | Actual seats necessary | Number of cars arriving | | Car demand | Headway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | By days | Average 15 min. | Average 30 min. | By days | Average 15 min. | Average 30 min. | 15 min. | 30 min. | | | By days | Av. | | |
| 3.00 to 3.15 | | | | | | | | | | | | | | | |
| 3.15 to 3.30 | | | | | | | | | | | | | | | |
| 3.30 to 3.45 | | | | | | | | | | | | | | | |
| 3.45 to 4.00 | | | | | | | | | | | | | | | |
| 4.00 to 4.15 | | | | | | | | | | | | | | | |
| 4.15 to 4.30 | | | | | | | | | | | | | | | |
| 4.30 to 4.45 | | | | | | | | | | | | | | | |
| 4.45 to 5.00 | | | | | | | | | | | | | | | |
| 5.00 to 5.15 | | | | | | | | | | | | | | | |
| 5.15 to 5.30 | | | | | | | | | | | | | | | |
| 5.30 to 5.45 | | | | | | | | | | | | | | | |
| 5.45 to 6.00 | | | | | | | | | | | | | | | |
| 6.00 to 6.15 | | | | | | | | | | | | | | | |
| 6.15 to 6.30 | | | | | | | | | | | | | | | |

Form 2226 (Standard size 4x9)

TRAFFIC CHECK

| Car number | Time arriving | Total passengers | Total Every 15 Minutes | | |
|---|---|---|---|---|---|
| | | | Passengers | Seats | Cars |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Date..........

Line.......... Checked at..........

Direction.......... From.......... M. to.......... M..........

Weather.......... Checked by..........

---

Form 0000 (Standard size 12x17½)

RECAPITULATION OF TRAFFIC CHECK

Line.......... Date..........

| PERIOD | | | | | | | |
|---|---|---|---|---|---|---|---|
| From | To | | | | | | |
| 6:00 | 6:15 | | | | | | |
| 6:15 | 6:30 | | | | | | |
| 6:30 | 6:45 | | | | | | |
| 6:45 | 7:00 | | | | | | |
| | | | | | | | |
| 11:00 | 11:15 | | | | | | |
| 11:15 | 11:30 | | | | | | |
| 11:30 | 11:45 | | | | | | |
| 11:45 | 12:00 | | | | | | |

In general the forms furnished observers provide for taking the following information:

(*a*) Name of line.
(*b*) Point of inspection.
(*c*) Origin, destination and direction of car observed.
(*d*) The car number.
(*e*) The run number.
(*f*) The time of arrival and departure.
(*g*) The number of passengers on car.

On the last point the practice is not uniform. Some cards require an estimate of the total number of passengers on a car as it passes the observation point. Others specify the number of passengers on car when arriving and leaving the observation point. The number getting on and off at each observation point has also been recorded occasionally.

In Cincinnati [1] the following information as to passengers was required:

(*a*) Total passengers on car as it arrives and as it leaves.
(*b*) Number of passengers standing in front and rear vestibules.
(*c*) Number of passengers standing in car body.
(*d*) Number of passengers boarding and leaving car.
(*e*) Group or type of passengers whether
 1. Wealthy or professional.
 2. Middle type and shoppers.
 3. Laboring people.

In determining the number of passengers on a car, practice has shown that close estimation of the number from the street on the basis of seating capacity (known by the inspector for each type of car) by adding for those standing and substracting for vacant seats is a sufficiently accurate method [2]— 95 per cent accuracy being attained by the inspectors as shown by check during the recent traffic survey in Milwaukee, by the Railroad Commission of Wisconsin.

In estimating the number of passengers it is customary to allow for those voluntarily standing.[3]

The proportion to which this preferential standing may extend is well brought out by an investigation by the Wisconsin Railroad Com-

---

[1] R. W. Harris, Report on Cincinnati Traffic Conditions, 1912.

[2] R. W. Harris, Report on Cincinnati Traffic Conditions, 1912: "Experience in collecting data of this character has shown this method (estimating from street) to be most accurate. In order to ascertain the correctness of the information thus collected, checkers were put on cars and an accurate count was made of a number of cars being observed by field inspectors. Considering the entire amount of data, the check indicates, on the whole, that the count on the street is 97 per cent accurate."

R. M. Feustel, Report on Winnipeg Street Railway Service — Manitoba Public Utilities Commission, 1913: "Checking was continued . . . rigidly . . . The car number and the time being taken each was a check on every other, as the car could be traced then from one end of the line to the other. This work was then again checked against the car counts (preliminary study) taken from same corner, and a very substantial agreement was had."

[3] Bion J. Arnold, Report on Transportation Facilities, City of San Francisco, 1913: "Allowance must be made, especially in San Francisco, for the existing fact that many passengers stand by preference even when seats are vacant."

mission covering many thousands of observations [1] and which showed that with a full car load as high as 20 per cent of the seating capacity represents standing by preference. The extent of preferential standing varies, of course, with local conditions among which may be noted type of equipment, rules, class of passengers, time of day, and length of ride.[2] Probably there is a considerable number of smokers who would rather stand if allowed to smoke, and when there are vacant seats, it is well to consider these.

The number of passengers on a car has been recorded in the past in several ways; either the actual number estimated or, for instance: light, medium, heavy (Wisconsin Railroad Commission); very light, light, full, crowded, overcrowded (1910 Committee on Construction of Schedules and Time Tables of the American Street and Interurban Railway Transportation and Traffic Association); or as no load (less than 6), comfortable load (8 or less standing), 8-20 standing, over 20 standing (St. Louis Public Service Commission); etc.

In addition to recording all of the above described data, the following additional items are usually considered to be of sufficient value to warrant their collection:

(*a*) Weather conditions throughout day.

(*b*) Abnormal occasions such as ball games, etc.

(*c*) General traffic conditions at observation points, both pedestrian and vehicular.[3]

Traffic may be classified as vehicular and pedestrian and again as: few; considerable but causing no delay; considerable and causing much delay.[4]

The transportation department of the old Metropolitan Street Railway of New York, classified delays to cars of 5-min. or over as follows:[5]

1. Blocking by vehicles.
2. Carelessness of employes.
3. Miscellaneous car trouble.

---

[1] Railroad Commission of Wisconsin, 13 W. R. C. R., 178.

[2] R. W. Harris in his report on the situation in Cincinnati makes the following statement: "The number of preferential standing passengers for any car load is peculiar to the conditions existing in each locality. In Madison, Wisconsin, 21 per cent of any load will stand by preference; in La Crosse, 15.5 per cent; in Lincoln, Nebraska, 14 per cent; in Milwaukee, 19 per cent, and in Cincinnati, 15.5 per cent."

R. B. Stearns, Vice-President of The Milwaukee Electric Railway and Light Co., made the following statement in the summer of 1914: "Since smoking on the cars in the Milwaukee system has been discontinued and pay within systems of folding doors and closed platforms adopted, a recent recalculation of the number of passengers standing by preference would indicate approximately 5 per cent as compared with 19 per cent a few years ago when smoking was permitted and all the cars were operated with open platforms, front and rear."

[3] Bion J. Arnold, Report on Transportation Facilities, City of San Francisco, 1913: "One very serious cause of the increased difficulties of giving adequate service is the interference of vehicle traffic . . . A very material improvement however has resulted from the institution of traffic regulations in this city (San Francisco) by the Traffic Squad of the Police Department, with results that heavy and slow moving vehicles are being gradually encouraged to seek and follow less congested thoroughfares, which has greatly facilitated passenger movement."

[4] A Method for Determining the Adequacy of an Electric Railway System, R. W. Harris—1910 *Proceedings American Institute of Electrical Engineers.*

[5] *Electric Railway Journal*, June 25, 1910, page 1088.

4. Accidents.
5. Plow trouble.
6. Electrical car trouble other than plow trouble.
7. Electrical transmission trouble.
8. Mechanical defects (cars).
9. Faulty track.
10. Fires.
11. Caused by outside lines.
12. Miscellaneous trouble.
13. Due to outside construction.
14. Due to obstruction in slot.

In order that any traffic study may furnish information of the greatest value to the officers of a transportation company, it must determine as far as practicable the causes of the variations in traffic demand and to do this it is necessary to note many items which may at first seem superfluous. It should be borne in mind that while the primary purpose of traffic studies is to permit the making of scientific schedules, there is frequent opportunity to use the information derived from such studies in prognosticating the future, in meeting complaints, and in stimulating traffic at times and places such as will make the increased traffic profitable.

The steps which must be taken in any community to determine the characteristics of the various lines will necessarily vary, but the following suggestions cover the field in a general way, and have formed the basis of inspectors' reports in various surveys:

1. Divide line into characteristic sections and discuss each under the heads:

   (*a*) Class of passengers.
   (*b*) Time of travel.
   (*c*) Probable destination.

2. Locate various origins of passengers along line, obtain destination and probable route (factories, etc.).

3. State transfer points and give idea as to number, in percentage of passengers leaving car, who transfer to other lines. If cars on more than one route operate over line, make separate estimates of interchange of traffic.

4. Determine attitude of public as regards service given by particular line (casual conversation).

5. Make a few specific observations (record counts) of movements of passengers (seated to vestibule and vice versa) in the car as it approaches a stop in downtown and outlying districts.

6. How does standing by preference vary with time of day, class of passengers, district, etc.

The method used in the Philadelphia traffic survey (1912) differed in many respects from all of the above and might be of comparative

interest though its ultimate purpose was somewhat different from most of the above mentioned studies. To quote from the report:[1]

> The present flow of traffic between all sections of the city was determined by a traffic survey made by the following *novel* and *practical* method.

A brief summary of the method there described follows:

1. A program was prepared from schedules in effect on the lines of the Philadelphia Rapid Transit Company providing for

    (*a*) the counting of passengers on about one car in every five (18-hour) cars operated.

    (*b*) about four lines a day were to be covered.

2. Two experienced conductors (borrowed from the Company and properly instructed and aided) were placed on each car.

    (*a*) the first stationed at the entrance, properly filled out and presented an identification slip to each passenger with a request to keep same until collected.

    (*b*) the second, stationed at the exit, collected such slips and noted on them, after inquiry, the passengers' destination.

3. The count slips were printed tickets, somewhat larger than street car transfers, were numbered serially and supplied in pads of 100. Different colored slips were used for each of four general directions of travel.

4. At end of each half trip all slips collected for it were enclosed in an envelope giving the following information:

    (*a*) Number of envelope corresponding to the number of half-trips counted.

    (*b*) Name of collector.

    (*c*) Date.

    (*d*) Name and number of line being counted.

    (*e*) Direction.

    (*f*) Time of beginning of half trip.

    (*g*) Number of slips enclosed.

    (*h*) Delays.

    (*i*) Unusual traffic movements.

    (*j*) Other notes.

5. The envelopes containing slips were turned in after midnight, each day, and were then sent to the Statistical Service Company. Here the information contained on slips was transferred to 24-column Hollerith cards, which were then electrically sorted and recorded.

6. No count was made on holidays, Saturdays and Sundays.

7. Checks were made by repeating the count on several lines. These recounts were found to agree satisfactorily with the originals.

8. The data recorded by the Statistical Service Company was returned to the survey office where it was further analyzed and charted.

[1] A. M. Taylor, The Solution of a City's Transit Problem — *Electric Journal*, October 1914, page 516.

Results are plotted into curves from which it can be readily seen wherein service is defective and recommendations for changes made accordingly.

This comment on the practice of the Board of Supervising Engineers, Chicago Traction, may well serve both as a statement of present general practice and as a recommendation to all engaged in the accumulation of traffic data.. Such curves simply represent a summary of observations, but for the great majority of those dealing with such matters the graphic representation of data is far more quickly interpreted than numerical tabulations.

A few typical curves, together with the data from which they are drawn, will be illustrated. An observer on a car noted the following passengers boarding and alighting during a run of 16 blocks.

Car No. 100

| Street | Passengers | | |
|---|---|---|---|
| | Boarding | Alighting | In car |
| 0 | 4 | ........ | 4 |
| 1 | 2 | ........ | 6 |
| 2 | 2 | ........ | 8 |
| 3 | 6 | 2 | 12 |
| 4 | 3 | ........ | 15 |
| 5 | 3 | 1 | 17 |
| 6 | ........ | ........ | 17 |
| 7 | 1 | ........ | 18 |
| 8 | 5 | 3 | 20 |
| 9 | 1 | ........ | 21 |
| 10 | ........ | ........ | 21 |
| 11 | ........ | ........ | 21 |
| 12 | 2 | ........ | 23 |
| 13 | ........ | 1 | 22 |
| 14 | ........ | 2 | 20 |
| 15 | ........ | 12 | 8 |
| 16 | ........ | 8 | ........ |

Fig. 19 shows this information graphically.[1] Data for, say, 15 or 30-min. periods can be combined readily and drawn in the same manner, or from street observations as to the number of passengers on the car, the car loading line can be drawn.

Fig. 20 serves to indicate whether unusual loading is due to distortion of headway or not, and also by the use of a line showing seating capacity, points out the relation between excess seats and standing passengers for the particular point on the line.

[1] When the stops are laid off on the base line to the scale of their distance apart in miles the area under this curve represents passenger miles, and divided by the total passengers on gives the average length of ride. The maximum ordinate will generally be less than the total "ons." The area between a horizontal line representing seating capacity and that part of the curve lying above the seating capacity line represents "standing passenger miles."

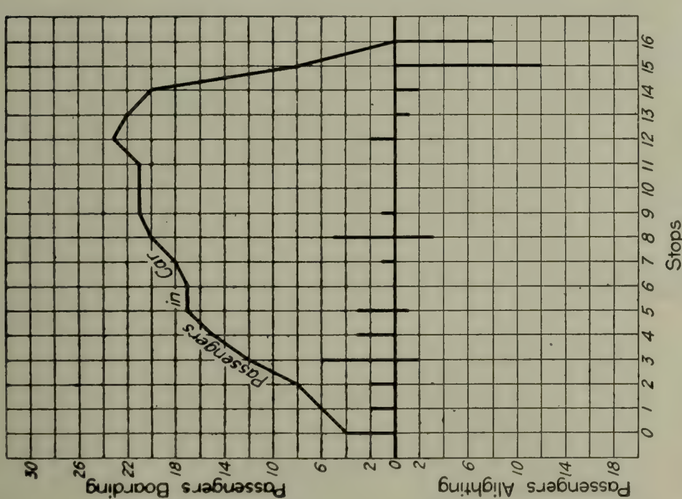



FIG. 19. LOADING OF ONE CAR AT ALL POINTS

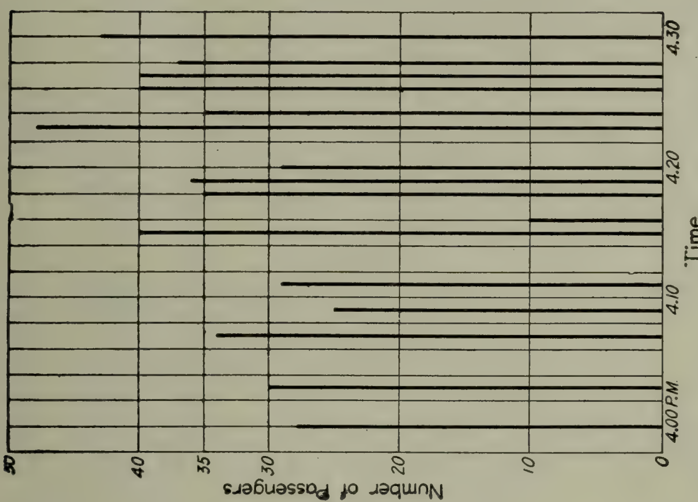



FIG. 20. LOADING OF ALL CARS AT ONE POINT

The variation in traffic throughout the day at any point may also be shown by a diagram similar to Fig. 20. Here an inspector stationed at one point throughout the day reports as follows:

MAIN STREET AT TWENTIETH
SOUTH BOUND

| Time | Car number | Passengers |
|---|---|---|
| 4:00 P. M. | 1260 | 24 |
| 4:03 P. M. | 1240 | 30 |
| 4:07 P. M. | 1229 | 34 |
| 4:09 P. M. | 1262 | 25 |
| 4:11 P. M. | 1271 | 29 |
| 4:15 P. M. | 1230 | 40 |
| 4:16 P. M. | 1231 | 10 |
| 4:18 P. M. | 1254 | 35 |
| 4:19 P. M. | 1247 | 36 |
| 4:20 P. M. | 1253 | 29 |
| 4:23 P. M. | 1242 | 48 |
| 4:24 P. M. | 1223 | 35 |
| 4:26 P. M. | 1218 | 40 |
| 4:27 P. M. | 1212 | 40 |
| 4:28 P. M. | 1226 | 37 |
| 4:30 P. M. | 1261 | 43 |

Of general application and frequent use, the following diagram combines several important features.

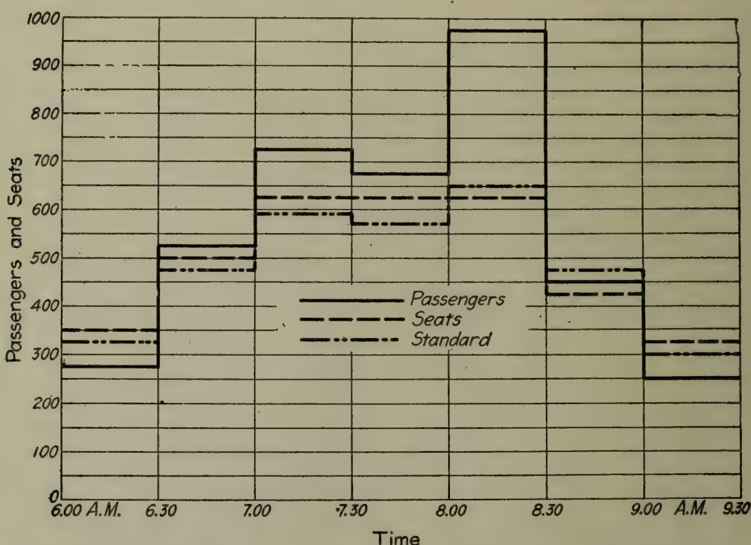



FIG. 21. SERVICE AND TRAFFIC AT ONE POINT BY 30-MINUTE PERIODS

An observer records for each car the number of passengers aboard and the time of passing the point of observation. The seating capacity

of cars being known, summaries are made (see Summary Sheet, The Milwaukee Electric Railway and Light Co., facing page 132), and the results plotted as indicated by Fig. 21. By plotting on the same figure the seats required by company standards, or by franchise standards or those of commissions, the sufficiency of the service can be quickly judged.

Other diagrams than those here illustrated will readily suggest themselves and will permit the setting forth of the tabular data in ways best fitted to the problem under examination.

## Summary

It is impossible to indicate other than very general conclusions with regard to the frequency of the collection of data. It may be concluded, however, that this is to an extent automatically determined by conditions already enumerated, but that in order to secure full advantage of fluctuations in traffic and to anticipate public complaints, the interval between such studies should be short. Moreover, such studies should be made not only for week days, but also for Saturdays and Sundays and not only for rush periods, but for non-rush periods as well. Further in order to estimate peak conditions accurately some traffic studies should always be made in the late fall and winter months.

The type of property will have an important bearing on this question and following the classification proposed in Chap. IX the varying requirements of different companies may be roughly stated as follows:

For the larger companies all lines should be subjected to a 24-hour study, covering week days, Saturdays, Sundays and holidays, and representing also traffic conditions throughout the various seasons of the year. The size of the department which it is necessary to maintain to make these studies, will depend upon the frequency with which it is desired to complete the study of all lines in the system and upon the number of lines it is possible for the department to consider at a time.

For the companies of medium size a 24-hour general study should be made periodically and 18-hour studies on the heaviest lines, in rotation.

For the small companies an 18-hour general study, supplemented by special data concerning the points of maximum loading on certain lines during rush hours will be sufficient.

No definite conclusion can be drawn as to the extent of data to be taken in any traffic study except that the more comprehensive the study made, the greater the value of the information secured. Stated very generally, however, experience indicates the following general procedure:

A preliminary study, covering a number of representative car trips during the different periods of the day and ascertaining the number of passengers at different points along the route, should be made for each line to determine the points of future observation. The points of maximum load and a number of others bringing out the character-

istics of the traffic on the line should be used as these points of observation, together with points at which there are cross-overs, which may be used for short routing. A car loading curve, based on the preliminary observations will help to locate the desired points.

The period of time covered by the observations on any one line at any one point should be long enough to give normal results, with twenty-four hours as the minimum.

Inspectors should be stationed at each observation point and should record accurately the following data for every car moving in either direction:

(*a*) Name of line.
(*b*) Point of inspection.
(*c*) Day and date.
(*d*) Weather.
(*e*) Origin, destination and direction of car.
(*f*) Car number.
(*g*) Run number.
(*h*) Time.
(*i*) Number of passengers on car.

The last named item should be estimated on the basis of seating capacity, by adding for those standing and subtracting for vacant seats (seating capacity of all types being known by inspectors). Allowance should be made for those voluntarily standing, varying from 5 to 20 per cent, according to conditions.

In addition to the above data any other pertinent remarks should be made, such as: ball game, street traffic light, medium, heavy, etc.

A general survey of each line indicating the following items should be made:

(*a*) Class of passengers.
  1. Business and professional.
  2. Middle type and shoppers.
  3. Laboring people.
(*b*) Time of travel.
(*c*) Probable origin and destination (factories, etc.).
(*d*) Transfer points and their effect.
(*e*) Attitude of public as regards service on the particular line.
(*f*) Other pertinent data.

It is possible to reach more definite conclusions concerning the extent of data to be taken and the manner of its determination by grouping companies in classes as has been previously done in discussing organization and frequency of studies. Adopting this plan the following paragraphs take up the question of method in greater detail:

It is neither necessary nor practicable to study the loading of every car at every point of a trip. It is desirable, however, and the larger

companies will obtain this information, to know the average number of passengers getting on and off each car at every point and this information should be obtained for twenty-four hours of the day and for various days and periods of the year. This information should be obtained by a sampling process: that is, by taking certain cars and certain points at one time and other cars and other points at other times. It will be found that the traffic characteristics of the various car trips will be very nearly alike from day to day, so that it will be possible to combine data concerning one car line taken to-day with that taken concerning another car line to-morrow, provided of course no unusual circumstances arise.

For companies of medium size the number of passengers getting on and off each car at important traffic points previously determined should be noted, and for the smaller companies an estimate should be made of the number of passengers on each car at the point of maximum loading during rush hours.

At the beginning of any traffic study all the lines should be listed and the general characteristics of the territory they serve should be recorded. The relation of these lines to each other will determine to a certain extent the order in which they will be studied and the general characteristics of the traffic on each line can be determined from conductors' trip reports and from a few rides of inspection prior to the beginning of the collection of specific data.

Each observer should be carefully instructed as to the observations which he is to make and he should be furnished with convenient forms ruled and with printed headings. It is very necessary that every effort should be made to place the observations on a comparable basis, inasmuch as the data from many observers is combined to make the final determination of the sufficiency of service on any line.

In addition to the data concerning the number of passengers on cars at various points, together with the identification of the car by route and time, the observer should record information concerning street traffic, unusual occasions, weather, etc., in order that the extreme variations may be eliminated from the statistical analysis. It is generally advisable also to determine the diversity of loading and for this purpose the passengers in each car passing a given point, for say fifteen-minute periods throughout the day, should be determined and the relation of the maximum to the average should be computed.

Certain typical forms for use in collecting and recording this information have been shown. After this data has been assembled it can be made of greatest value by being represented graphically.

There are three general types of curves which it is found helpful to prepare from the traffic data collected. These are: First, a curve on the horizontal axis of which is laid off the various streets passed in a car trip and where parallel to the vertical axis and above the horizontal axis there is laid off a line proportional in length to the number of passengers boarding the car at each street and below the horizontal

axis, a similar line, representing the number of passengers leaving the car at each street. By computing the cumulative difference of passengers on and off, the curve showing the number of people on the car at each street can be drawn.

The second typical curve shows the number of passengers on each car passing a given point and the time at which the car passed the point. The vertical lines representing the number of passengers on the car are drawn at horizontal distances representing the time, and a line connecting the upper extremities of the vertical lines represents the loading at any point throughout the period of study. The distance between the lines indicates of course the headway of cars and whether or not unusual loadings were due to irregular spacing of cars.

The third general type of curve is one which is plotted for any given point on a line showing for each fifteen or thirty-minute period during the time under observation the number of passengers carried by the point, the number of seats furnished and the number of seats which should be furnished in order to conform to the company's rules or to regulations laid down by some controlling body.

The following chapter will take up the analysis of these curves and their application to the problem of constructing time tables which is, of course, the immediate purpose of the traffic survey.

There are other ways, however, in which the traffic survey department can be of value to those in charge of the property, and all data should be further analyzed for suggestions as to means of stimulating traffic on such lines and at such times as will make it a profitable addition to the business. There are many questions which the traffic survey department is in a position to investigate and shed light upon, and it should be an able ally of the Traffic Department.

# CHAPTER XI

## THE APPLICATION OF TRAFFIC DATA

The Determining Factors in Schedule Making,——Minimum Headway,—— Meeting Points,—— Use of Trippers,—— Traffic Requirements,—— Transition Period,—— Short Routing,—— Other Considerations. Average Length of Ride,—— Average Length of Ride of Standing Passenger. Traffic Data in Service Cases :—— Frequency of Heavy Loads,—— Factors Affecting Ratio of Seats to Passengers,—— Factors Affecting Determination of Standard of Loading,—— Relation of Maximum to Average Loading,—— Instantaneous Ratios not Significant,—— Necessary Factors in Loading Rules,—— Permissible Variation from Normal Service.

Chapters VIII, IX and X have dealt with the need for accurate knowledge concerning the distribution of traffic over the lines of an electric railway and have discussed the sytematic and accidental variations in this traffic from hour to hour and from day to day. Something has been said as to the extent of the data to be gathered and the frequency of traffic surveys, together with reference to the departmental organization which should have charge of the work. In Chapter XVI there will be discussed the problem of fitting car miles to passenger miles in the light of the fact that rush hour service is more expensive than service at other times during the day. In the present chapter it is proposed to consider the application of traffic data with particular reference to the methods of constructing schedules based on the information collected in the study of traffic.

On lines where traffic is light the determining factor in schedule making is, in most cases, the minimum frequency of service permitted. The headway may be prescribed by ordinance or may be adopted by the management as the minimum headway necessary to develop the traffic. On single track lines as the amount of traffic increases, the schedules are still controlled by a definite headway determined by the location of passing tracks and intersections. To meet further increases in traffic, trippers are run, which in effect increase the capacity of the regular cars but do not serve to materially alter the headways. With double track lines, the schedules become more elastic, but still tend to follow the form developed under single track operation. Eventually, with the growth of communities, the making of schedules outgrows the rules of practice inherited from simpler conditions and as has been previously pointed out, there arises the necessity for traffic studies as a means of fitting the service rendered to the demand for such service.

On lines of considerable traffic density, the starting point in schedule making is the determination of the number of cars required under existing service regulation, to carry the passengers moving in the controlling direction and past controlling points on the line during the heavier 15 or 30-minute periods of the day. Having determined these

requirements, the next step of the process is the scheduling of the required cars for earlier and later periods, or until such a time as they are not required by traffic conditions. These cars must then be scheduled back to the time when they must leave the barns and continued until they can be returned.

| Streets | 3 P.M.–15 | 15–30 | 30–45 | 45–4:00 | 4:00–15 | 15–30 | 30–45 | 45–5:00 | 5:00–15 | 15–30 | 30–45 | 45–6:00 | 6:00–15 | 15–30 | 30–45 | 45–7:00 | 7:00–15 | 15–30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outbound A | 12 (1) | 14 (1) | 16 (1) | 17 (1) | 17 (1) | 19 (1) | 20 (1) | 22 (1) | 46 (1) | 48 (1) | 50 (1) | 51 (1) | 40 (1) | 38 (1) | 37 (1) | 35 (1) | 11 (1) | 10 (1) |
| B | 15 (1) | 16 (1) | 18 (1) | 19 (1) | 22 (1) | 24 (1) | 26 (1) | 27 (1) | 114 (2) | 116 (3) | 117 (2) | 118 (2) | 77 (2) | 74 (2) | 72 (2) | 70 (2) | 19 (1) | 15 (1) |
| C | 21 (1) | 22 (1) | 24 (1) | 25 (1) | 30 (1) | 33 (1) | 35 (1) | 37 (1) | 170 (3) | 172 (4) | 173 (3) | 175 (3) | 142 (3) | 124 (3) | 122 (3) | 100 (3) | 26 (1) | 22 (1) |
| D | 25 (1) | 26 (1) | 28 (1) | 30 (1) | 45 (2) | 48 (2) | 50 (1) | 51 (2) | 230 (4) | 235 (5) | 237 (4) | 242 (4) | 235 (5) | 200 (4) | 195 (4) | 150 (4) | 30 (1) | 28 (1) |
| E | 41 (1) | 43 (1) | 45 (2) | 46 (2) | 65 (2) | 67 (2) | 68 (2) | 70 (2) | 280 (5) | 282 (5) | 284 (5) | 287 (5) | 248 (5) | 246 (5) | 238 (5) | 221 (5) | 44 (2) | 40 (1) |
| F | 49 (2) | 51 (2) | 51 (2) | 52 (2) | 70 (2) | 72 (2) | 73 (2) | 75 (2) | 290 (6) | 296 (6) | 298 (5) | 303 (5) | 266 (5) | 264 (5) | 260 (6) | 222 (5) | 56 (2) | 49 (2) |
| G | 52 (2) | 53 (2) | 53 (2) | 54 (2) | 76 (2) | 79 (2) | 80 (2) | 82 (2) | 298 (6) | 310 (6) | 312 (5) | 321 (5) | 302 (6) | 290 (6) | 280 (6) | 223 (5) | 62 (2) | 61 (2) |
| H | 57 (2) | 58 (2) | 59 (2) | 61 (2) | 80 (2) | 83 (2) | 86 (2) | 96 (2) | 300 (6) | 314 (6) | 316 (5) | 330 (6) | 303 (6) | 296 (6) | 286 (6) | 240 (5) | 81 (2) | 77 (2) |
| I | 62 (2) | 67 (2) | 69 (2) | 72 (2) | 83 (2) | 93 (3) | 94 (2) | 104 (3) | 315 (6) | 325 (6) | 327 (6) | 336 (6) | 308 (6) | 299 (6) | 288 (6) | 249 (6) | 93 (3) | 87 (3) |
| J | 60 (2) | 65 (2) | 66 (2) | 68 (2) | 70 (2) | 74 (2) | 75 (2) | 80 (2) | 250 (5) | 271 (5) | 272 (5) | 292 (5) | 275 (5) | 256 (5) | 254 (6) | 232 (5) | 80 (2) | 70 (2) |
| K | 55 (2) | 58 (2) | 61 (2) | 62 (2) | 63 (2) | 63 (2) | 64 (2) | 65 (2) | 207 (4) | 227 (5) | 248 (4) | 268 (5) | 243 (5) | 243 (5) | 242 (5) | 222 (5) | 75 (2) | 68 (2) |
| Inbound J | 56 (2) | 59 (2) | 62 (2) | 63 (2) | 63 (2) | 64 (2) | 65 (2) | 66 (2) | 203 (4) | 205 (4) | 206 (4) | 208 (4) | 216 (4) | 214 (4) | 212 (5) | 190 (4) | 73 (2) | 67 (2) |
| I | 62 (2) | 64 (2) | 65 (2) | 66 (2) | 67 (2) | 68 (2) | 69 (2) | 75 (2) | 160 (3) | 163 (3) | 163 (3) | 165 (3) | 171 (4) | 170 (4) | 169 (4) | 165 (4) | 75 (2) | 73 (2) |
| H | 72 (2) | 71 (2) | 71 (2) | 69 (2) | 68 (2) | 70 (2) | 70 (2) | 77 (2) | 129 (3) | 125 (3) | 120 (2) | 118 (2) | 115 (2) | 112 (2) | 110 (3) | 109 (3) | 72 (2) | 71 (2) |
| G | 73 (2) | 72 (2) | 71 (2) | 71 (2) | 68 (2) | 69 (2) | 70 (2) | 76 (2) | 117 (3) | 115 (2) | 114 (2) | 112 (2) | 85 (2) | 82 (2) | 80 (2) | 78 (2) | 51 (2) | 50 (2) |
| F | 63 (2) | 56 (2) | 53 (2) | 50 (2) | 40 (1) | 45 (2) | 57 (2) | 63 (2) | 100 (2) | 103 (2) | 105 (2) | 99 (2) | 72 (2) | 71 (2) | 70 (2) | 67 (2) | 35 (1) | 34 (1) |
| E | 60 (2) | 55 (2) | 50 (2) | 45 (2) | 34 (1) | 30 (1) | 30 (1) | 41 (1) | 67 (2) | 83 (2) | 82 (2) | 66 (1) | 50 (1) | 45 (1) | 45 (1) | 40 (1) | 21 (1) | 20 (1) |
| D | 58 (2) | 52 (2) | 40 (1) | 30 (1) | 20 (1) | 22 (1) | 23 (1) | 25 (1) | 50 (1) | 60 (2) | 61 (1) | 51 (1) | 42 (1) | 37 (1) | 31 (1) | 25 (1) | 19 (1) | 19 (1) |
| C | 40 (1) | 38 (1) | 34 (1) | 31 (1) | 30 (1) | 18 (1) | 18 (1) | 30 (1) | 33 (1) | 34 (1) | 35 (1) | 29 (1) | 28 (1) | 27 (1) | 25 (1) | 20 (1) | 16 (1) | 16 (1) |
| B | 33 (1) | 28 (1) | 24 (1) | 20 (1) | 15 (1) | 15 (1) | 15 (1) | 16 (1) | 16 (1) | 16 (1) | 15 (1) | 15 (1) | 15 (1) | 18 (1) | 21 (1) | 18 (1) | 12 (1) | 12 (1) |
| A | 28 (1) | 25 (1) | 20 (1) | 17 (1) | 16 (1) | 15 (1) | 10 (1) | 6 (1) | 4 (1) | 5 (1) | 5 (1) | 5 (1) | 10 (1) | 15 (1) | 20 (1) | 17 (1) | 13 (1) | 11 (1) |
| Passengers per Car Allowed | 40 | 40 | 40 | 40 | 40 | 40 | 48 | 48 | 56 | 56 | 64 | 64 | 56 | 56 | 48 | 48 | 40 | 40 |

Time

FIG. 22. TRAFFIC AND REQUIRED SERVICE

The applications of traffic requirements, that is, the scheduling of cars to meet the requirements, is largely mechanical but must be sup-

plemented by certain adjustments made in the light of experience to permit of the practical operation of the schedule. A typical illustration, developing a schedule for a single line[1] will explain the process. The illustration must be followed with important qualifications in mind. Schedule making is too complicated to lend itself to fixed or rigid rules. The location of car barns, transfer points, and traffic hazards are some of the factors that require judicious treatment in each case. The illustration deals only with general principles and only passing reference is made to certain complications encountered in a simplified application.

There will be assumed as a typical case a line four miles long for which the traffic count has been made and for which the normal number of passengers passing a number of points during each fifteen minutes of the day is known.

Fig. 22 is a diagram representing, along the horizontal axis, the time of day, and along the vertical axis, distances. The horizontal lines indicate the street intersections at which traffic counts were taken and the vertical lines divide the time into 15-minute periods. As originally drawn, this figure as well as the following figures, included the entire 24 hours, but for larger scale and simplicity, the diagrams reproduced have been abbreviated to include a few hours only. The larger numbers in Fig. 22 represent the number of passengers carried from each point during each 15-minute period, as determined by averaging a number of observations. The smaller numbers — those in parentheses — represent the number of cars required by the standards of service under which the company is operating. It will be noted from figures below the base line, that the allowed number of passengers per car varies, the assumed service standards permitting an average of 64 passengers in a car seating 44 people during the rush hour, and an average of only 40 passengers through the middle of the day or non-rush period. This standard permits a gradual adjustment of service to traffic during the periods preceding and following the time of maximum loading. The numbers representing the cars required in each 15-minute period were determined by dividing the corresponding numbers by the allowable number of passengers per car.

Fig. 23 shows in diagonal lines the second step in determining the service to be furnished. The figures inset in the horizontal lines correspond to the number of cars required under the service standards as shown in Fig. 22. The figures at the ends of diagonal lines represent runs and when the run number is enclosed by a circle the run begins or terminates at that time.

[1] When cars on more than one route operate over the same track for a part of their journey, the case may be treated by considering track used jointly as a separate line, or by dividing the local traffic over this part of the line between the two routes and then handling each route separately. Before decision is made as to the best method of handling such jointly operated track, it is well to examine the whole of each route separately to see if the controlling points do not occur elsewhere.

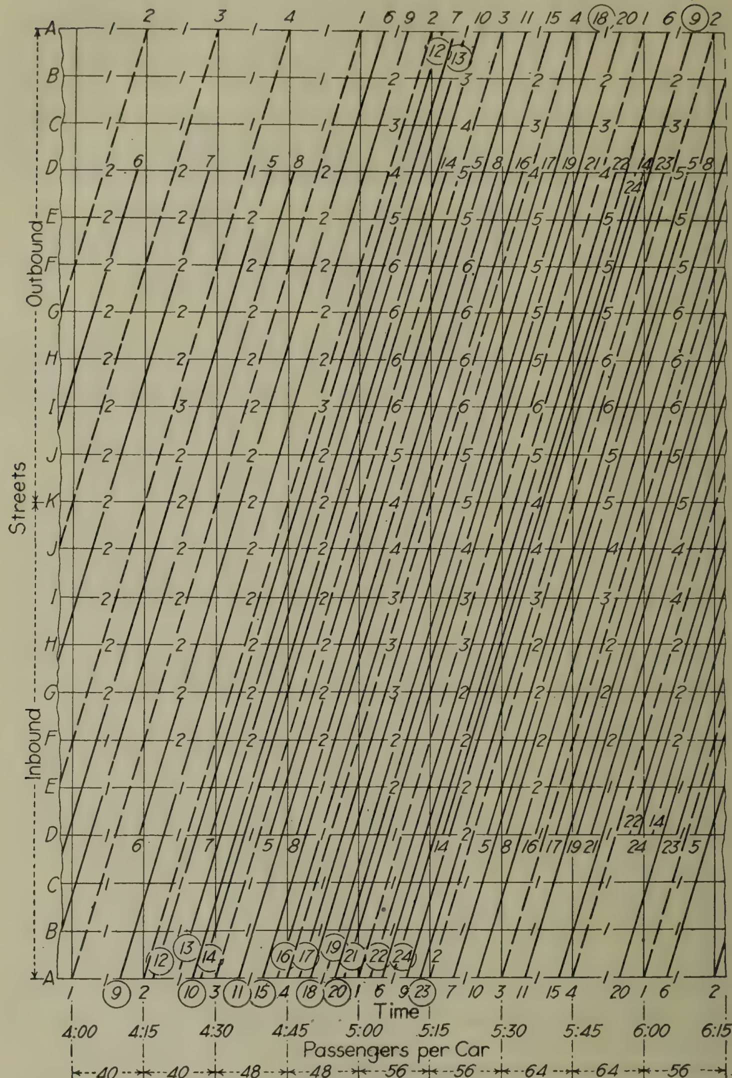



FIG. 23. PRELIMINARY GRAPHICAL TIME-TABLE

The dotted lines represent cars run under the assumed requirement that the maximum headway on this line shall be 15 minutes. Cross-overs are located at streets D and I and are used to short-route cars in either direction. From Fig. 22 it is evident that five additional cars must pass the streets, I, H and G during each 15 minutes from 5:00 to 5:30, and these are therefore indicated in Fig. 23. The construction of the schedule is begun at this point, it being here that the maximum traffic demand is found. These cars are scheduled before and after this time to the point at which they are no longer needed and

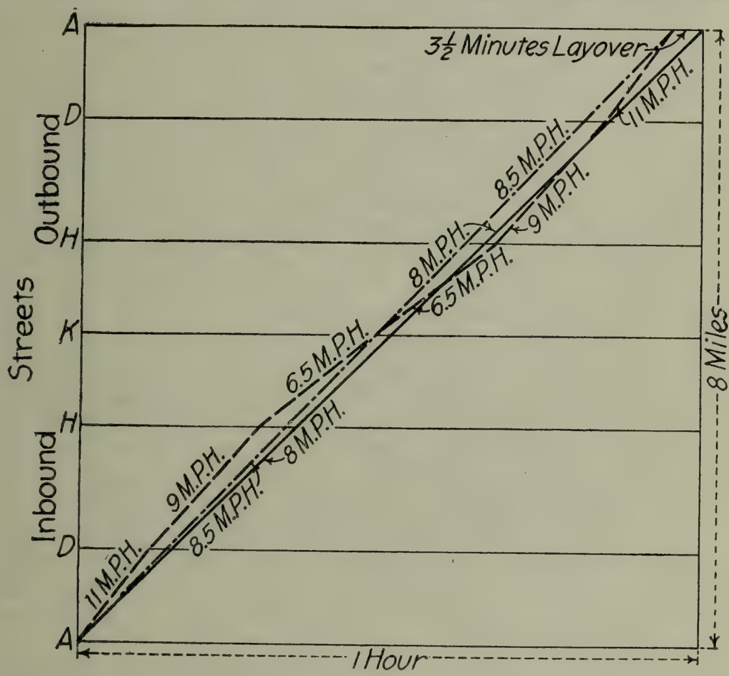



FIG. 24. RELATION BETWEEN AVERAGE AND SPECIFIC SPEED

can be returned to the barns which have been assumed to be located at A street. Cars are short-routed at D and I Streets wherever possible, thus permitting the minimum mileage[1] for the service rendered. Short-routing occurs chiefly at D Street both morning and evening, but also at I Street during the morning hours.

In drawing Fig. 23, an average speed of 8 miles per hour, including lay-over, was assumed as the result of experience. Speed will be different over different parts of the run, and this variation will next be

[1] It must be borne in mind, of course, that the minimum mileage here indicated cannot generally be realized completely, as it is unwise to ask passengers to transfer to the car following in all cases where that car normally would have room for them. Some consideration must be given to diversity of traffic, in addition to the consideration already given to this factor in fixing the off-peak capacity of cars at less than the number of seats.

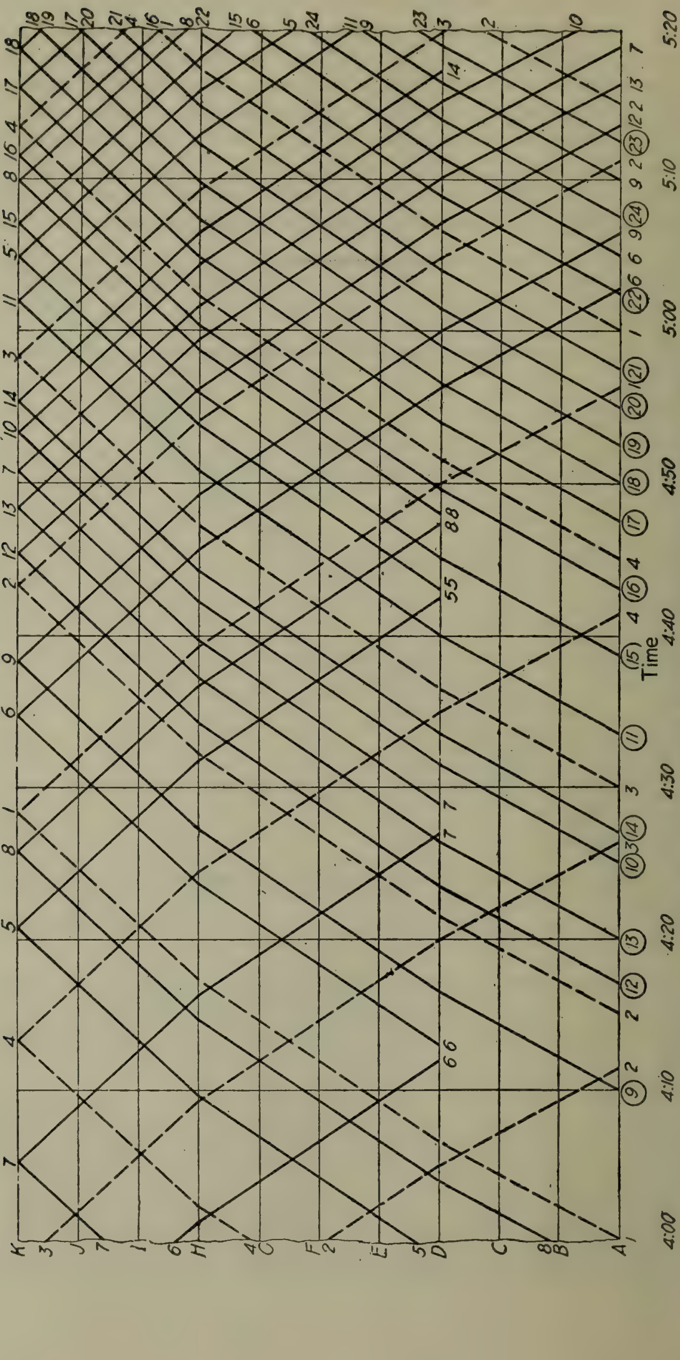



Fig. 25. Portion of Completed Graphical Time-Table

taken into account. Observation and experience, it will be assumed, have indicated that while the run from A Street to K Street and return, 8 miles, can be made in one hour, the average speed between streets A and D will be 11 miles per hour; between D and I, 9 miles per hour, and between I and E, 6.5 miles per hour.[1] The straight diagonal lines of Fig. 23 will then have to be warped and time points and the final schedule subsequently determined. Fig. 24 indicates how the average speed of 8 miles per hour is obtained under typical conditions.

The schedule thus devised is based on traffic requirements, but modified to take into account possibilities of short-routing, ordinance requirements as to headway, location of car barns and variable speed throughout different parts of the route.[2]

Fig. 25 indicates a portion of the graphic schedule shown in Fig. 23 and adjusted to meet operating conditions. In Fig. 22 and 23, the movement of a car from A Street to K Street and return to A Street is indicated by a line passing from the bottom to the top of the figure, these extreme lines representing the same street. Fig. 25 is a type of diagram more generally used to represent schedules and in it inbound cars are indicated by lines sloping upward to the right, while outbound cars are represented by lines sloping downward to the right. Fig. 25 is the more common form but on account of the difficulty of showing thereon the number of cars required in two directions and the confusion resulting from the many intersections of lines, the form used in Fig. 22 and Fig. 23 appears to be preferable for preliminary work. Time-tables of the usual types can now be taken off without difficulty, and from the graphic chart the trainmaster can at all times determine the location of all equipment in service and can see most readily the possibilities of expansion and contraction of service as traffic requirements vary.

No attempt has been made to indicate assignment of crews as this will depend upon agreements in effect locally as to hours of service and as to the relation between "lay-over" and "running" time.

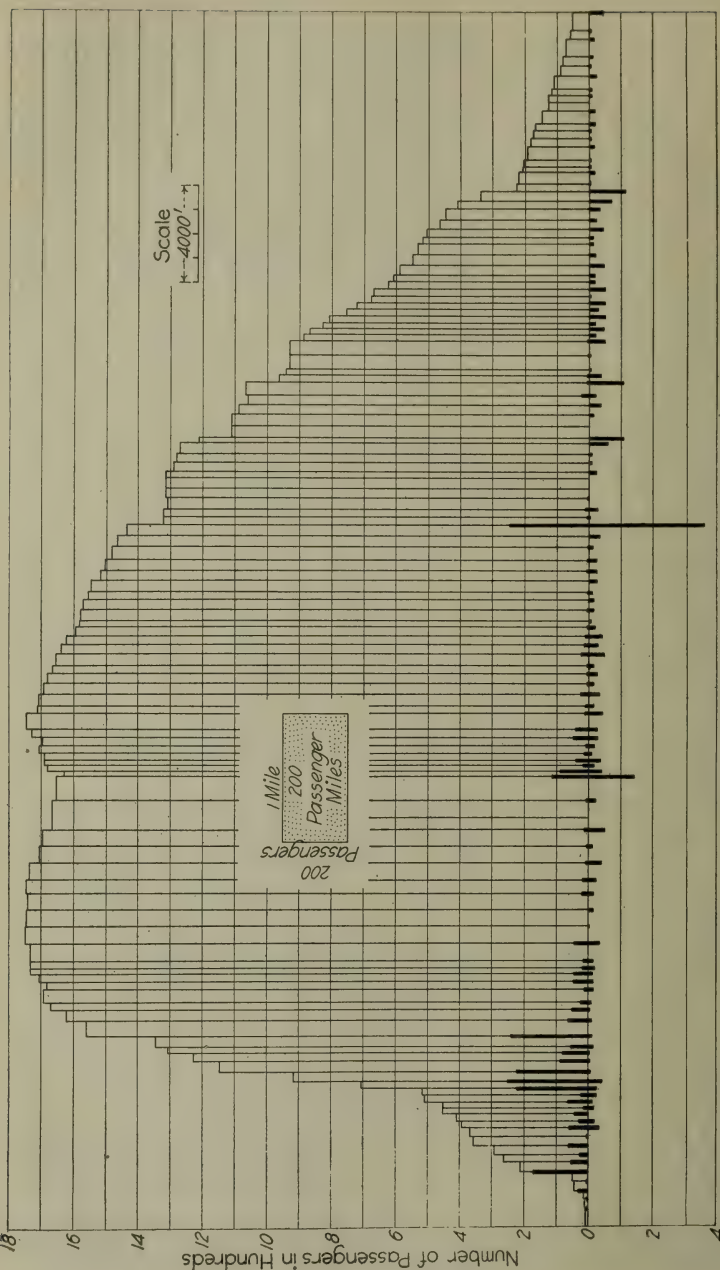
This problem illustrates one of the more important practical applications of the traffic study. In addition to the construction of time tables the traffic study serves as the basis for rerouting of cars, the adjustment of transfer points and similar problems. There are various other uses to which the data collected in making a traffic survey may be put. For example, it is frequently necessary in considering special problems to determine the average length of ride of passengers.

---

[1] Variation in speed from hour to hour during the day will necessitate the use of several average and several specific speeds to complete other parts of the schedule.

[2] A very complete analysis of these factors and others which make necessary in particular cases a departure from a schedule conforming precisely to the occurrence of traffic as determined by check, is contained in a paper read before the Public Service Railway section of the American Electric Railway Association on April 16, 1914, by Alexander Jackson, head of the time table department of the Public Service Railway Co., Newark, New Jersey.— *Electric Railway Journal*, April 18, 1914.

Such factors as make it necessary to vary from the service indicated by a traffic count are encountered in any scheme of schedule construction and are not to be considered as discounting the value of the traffic study, but rather as emphasizing its value by fixing definitely the required service and avoiding the possibility of adjusting the service away from, rather than in accordance with the requirements of the traffic.




Distances Between Car Stops to Scale

FIG. 26. PASSENGER MILES ON A TYPICAL LINE

Fig. 19, Chapter X, shows the number of passengers customarily riding past each point of a line upon which a traffic count had been made and the method of the construction of this figure is there indicated.

Fig. 26 was drawn from a traffic count recently made in a western city and from this figure the average length of ride will be determined. The ordinates of this diagram indicate to scale the number of passengers passing each street, and the abscissas represent distances along the line. Both ordinates and abscissas are drawn to scale. Any elementary area under this curve represents the product of passengers and distance, or to some scale, passenger miles. If then the total area under the curve be computed,[1] it will represent the total passenger miles made on the line. From the original data on which the diagram is based or from conductors' trip reports there can be determined the total number of passengers carried which, it should be observed, will be in general somewhat greater than the number of passengers as indicated by the maximum ordinate of the diagram. The total passenger miles divided by the number of passengers gives the average ride. The total area under the curve is 131.5 sq. in. and as one square inch represents 75.76 passenger miles the total area represents 9 966 passenger miles. The total number of passengers is determined from the original data to be 2 989. The passenger miles divided by the number of passengers is thus found to give 3.33 miles as the average length of ride.

It is occasionally desired to ascertain that part of the average ride during which the passenger is unable to secure a seat. The procedure to be followed in determining this consists of drawing across the diagram a horizontal line representing the total number of seats passing the different streets, and determining the area under the curve and above this line. This area when divided by the total number of passengers gives the average length of standing ride. Since not all of the passengers stand, it is occasionally necessary to determine the average distance ridden while standing, by those passengers not seated throughout the trip. It is necessary in determining this figure to make the assumption that at each stop the seats vacated by passengers leaving the car are taken by those passengers already standing in the car. A computation based on typical data follows:

From Table XXVI it is evident that the riding of standing passengers was equivalent to one passenger riding 420 blocks, but only a part of the 300 passengers were obliged to stand at all. If the data are grouped as in Table XXVII the number of passengers who stood may be determined. In that table the number of passengers boarding at each street is entered in the right hand column and across the top under the street numbers, the passengers alighting. At Sixth Street, for example, 20 passengers board and none finds a seat, the ten vacated having been taken by passengers boarding at Fifth Street. At Seventh Street five find seats and the remaining 15, at Eighth

[1] Due to the varying distances between stops, it will generally be found advantageous to compute this area by use of the planimeter.

Street. The streets at which other passengers find seats are determined similarly.

TABLE XXVI — LOADING DATA.

| STREET | Passengers: Boarding | Passengers: Alighting | Passengers: Load | Standing passengers |
|---|---|---|---|---|
| 0 | 40 | ........ | 40 | ......... |
| 1st | 20 | ........ | 60 | ......... |
| 2d | 20 | ........ | 80 | ......... |
| 3d | 60 | 20 | 120 | ......... |
| 4th | 30 | ........ | 150 | ......... |
| 5th | 30 | 10 | 170 | 10 |
| 6th | 20 | 10 | 180 | 20 |
| 7th | 10 | 5 | 185 | 25 |
| 8th | 40 | 20 | 205 | 45 |
| 9th | 10 | 5 | 210 | 50 |
| 10th | ........ | ........ | 210 | 50 |
| 11th | ........ | ........ | 210 | 50 |
| 12th | 20 | ........ | 230 | 70 |
| 13th | ........ | 10 | 220 | 60 |
| 14th | ........ | 20 | 200 | 40 |
| 15th | ........ | 120 | 80 | ......... |
| 16th | ........ | 80 | ........ | ......... |
| Total | 300 | 300 | 2,550 | 420 |

The data shown in Table XXVI may be rearranged in the form of Table XXVII.

TABLE XXVII — LENGTH OF STANDING RIDE OF PASSENGERS BOARDING AT VARIOUS STREETS

| STREET | OFF / ON | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th | 14th | 15th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *20 | 10 | 5 | 20 | 5 | ... | ... | ... | 10 | 20 | 120 |
| 5th | 30 | 10 | (10) | ... | ... | ... | ... | ... | ... | ... | ... | .... |
| 6th | 20 | ... | 20 | 15 | (15) | ... | ... | ... | ... | ... | ... | .... |
| 7th | 10 | ... | ... | 10 | 5 | (5) | ... | ... | ... | ... | ... | .... |
| 8th | 40 | ... | ... | ... | 40 | 40 | 40 | 40 | 40 | 30 | 10 | (10) |
| 9th | 10 | ... | ... | ... | ... | 10 | 10 | 10 | 10 | 10 | 10 | (10) |
| 10th | ..... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .... |
| 11th | ..... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .... |
| 12th | 20 | ... | ... | ... | ... | ... | ... | ... | 20 | 20 | 20 | (20) |
| 13th | ..... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .... |
| 14th | ..... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .... |

* Includes vacant seats.

The data shown in Table XXVII may be summarized as indicated in Table XXVIII.

An increasingly important function of traffic surveys is the furnishing of information for use in cases in which the service of a utility is under investigation. As an example of the analysis of data secured by traffic surveys, the following paragraphs abstracted from the testi-

mony and exhibits of The Milwaukee Electric Railway and Light Co. in a recent service case before the Railroad Commission of Wisconsin, are of great interest.

TABLE XXVIII — SUMMARY OF DATA IN TABLE XXVII

| Passengers | | | Stand | | |
|---|---|---|---|---|---|
| On at street | Total | Of whom | From | To | Passenger blocks |
| 5th | 10 | 10 | 5th | 6th | 10 |
| 6th | 20 | 15 | 6th | 8th | 30 |
| | | 5 | 6th | 7th | 5 |
| 7th | 10 | 5 | 7th | 9th | 10 |
| | | 5 | 8th | 9th | 5 |
| 8th | 40 | 10 | 8th | 15th | 70 |
| | | 20 | 8th | 14th | 120 |
| | | 10 | 8th | 13th | 50 |
| 9th | 10 | 10 | 9th | 15th | 60 |
| 12th | 20 | 20 | 12th | 15th | 60 |
| | 110 | | | | 420 |

$$\frac{420 \text{ Passenger blocks}}{110 \text{ Passengers}} = 3.8 \text{ blocks average length of standing ride.}$$

Note:— The average standing ride of all passengers is

$$\frac{420}{300} = 1.4 \text{ blocks.}$$

The fundamental data of a traffic study are shown for a typical line in the following table.

TABLE XXIX — TRAFFIC OBSTRUCTIONS

| TIME | Number of passengers on car | TIME | Number of passengers on car |
|---|---|---|---|
| 6:00 | ..... | 6:22½ | 60 |
| 6:02 | 85 | 6:24 | 65 |
| 6:03 | 90 | 6:24½ | 55 |
| 6:04 | 93 | 6:25 | 14 |
| 6:05 | 67 | 6:25½ | 9 |
| 6:06 | 95 | 6:26 | 59 |
| 6:08 | 90 | 6:27 | 56 |
| 6:12 | 100 | 6:28 | 52 |
| 6:15 | ..... | 6:28½ | 40 |
| 6:19 | 90 | 6:29 | 32 |
| 6:19½ | 80 | 6:30 | ...... |
| 6:20 | 87 | | |
| 6:21 | 87 | Total number of passengers | 1,471 |
| 6:22 | 65 | | |

Inasmuch as the question at issue regards the frequency of heavily loaded cars, the material in Table XXIX is re-grouped, the cars being classified according to the number of passengers carried.

TABLE XXX — CARS GROUPED BY LOADING

| NUMBER OF PASSENGERS ON CAR | Number of cars | Assumed range for classification | Number of cars | Passengers in range |
|---|---|---|---|---|
| 100 | 1 | 90–100 | 6 | 558 |
| 95 | 1 | | | |
| 93 | 1 | | | |
| 90 | 3 | | | |
| 87 | 2 | 80–89 | 4 | 339 |
| 85 | 1 | | | |
| 80 | 1 | | | |
| 67 | 1 | 60–69 | 4 | 257 |
| 65 | 2 | | | |
| 60 | 1 | | | |
| 59 | 1 | 50–58 | 4 | 222 |
| 56 | 1 | | | |
| 55 | 1 | | | |
| 52 | 1 | | | |
| 40 | 1 | 40–49 | 1 | 40 |
| 32 | 1 | 0–39 | 3 | 55 |
| 14 | 1 | | | |
| 9 | 1 | | | |
| 1,471 | 22 | ........ | 22 | 1,471 |

Table XXX is summarized and the results shown in Table XXXI.

TABLE XXXI — DISTRIBUTION OF TRAFFIC

| RANGE OF LOADING | Number of passengers | Per cent of total passengers | Number of cars | Per cent of total cars |
|---|---|---|---|---|
| 90–100 | 558 | 37.95 | 6 | 27.27 |
| 80– 89 | 339 | 23.04 | 4 | 18.18 |
| 70– 79 | ........ | ........ | ........ | ........ |
| 60– 69 | 257 | 17.45 | 4 | 18.18 |
| 50– 59 | 222 | 15.08 | 4 | 18.18 |
| 40– 49 | 40 | 2.72 | 1 | 4.54 |
| 0– 39 | 55 | 3.74 | 3 | 13.63 |
| Totals | 1,471 | 100.00 | 22 | 100.00 |

Fig. 27 (Cumulative Frequency Curve) is based on the data shown in Table XXXI. From the above table it appears that the average load per car is 66.9 passengers. The range of greatest frequency is between 90 and 100. The loading group on either side of which there is an equal number of cars is 56 to 59. The standard deviation or coefficient of variability is 3.14.

Table XXIX shows that the loading on cars varied from 9 passengers as a minimum to 100 as a maximum. The same table also shows that there was considerable distortion of headway during the half-hour period. There were 22 cars passing the point of observation on an average headway of 1.36 minutes between cars. During the period

from 6:08 to 6:12, 4 minutes, there were no cars and likewise during the period from 6:12 to 6:19 there were none. These excessive variations from the mean headway account for the heavy loading on the cars passing at 6:12 and 6:19.

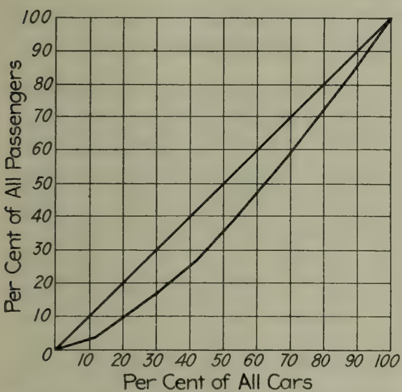



FIG. 27. DISTRIBUTION OF PASSENGERS AMONG CARS

If the period from 6:08 to 6:21 be considered, it will be observed that the elapsed time is 13 minutes, the number of passengers 444, the passengers per minute 34.1, the number of cars 5, the average load per car 88 passengers, and the cars per minute 0.38.

If the average headway had been maintained during this period there would have been 9.57 cars in which case the loading per car would have been 46.4 passengers.

Thus it appears that the average headway during the half-hour period if applied during the period of greatest loading would have reduced the actual loading to a point approximately the seating capacity of the cars.

Variation in loading as between individual cars is bound to occur because there is no way of always anticipating the times at which passengers will desire to ride. Some excess capacity will be required to take care of this variation in loading. Obviously this excess capacity should be reduced as the demand for service decreases.

Some overloading of cars will occur for the same reasons. There should, however, be little overloading under a proper schedule. Overloading of successive cars will occur if there has been some delay or distortion of scheduled headway. The greater the distortion, the greater will be the overloading on individual cars and the greater the number of cars so affected.

It is a basic principle of statistics that extreme variations should be eliminated in an endeavor to arrive at normal conditions or constants.

Results from observations taken on one day at one point cannot be used for drawing conclusions. It is accordingly desirable to ascertain the same factor for each of the other points of observation and also for all points as a whole to show the resultant relation between passengers and cars. Some points will show higher loadings per car and wider variations, while there will also appear cases where the loading is more uniform.

The effect of overloading becomes more serious as the distance of

travel through which such overloading occurs becomes longer. Overloading to the same degree for short distances is not as serious as for longer distances, since the degree of discomfort is a function of time, that is, distance travelled. Single points of overloading do not necessarily indicate great discomfort.

The composite results of similar observations on the same line and at the same point of observation disclose the following results:

TABLE XXXII — COMPOSITE RESULT OF PASSENGER COUNT AS OBSERVED JANUARY 29, FEBRUARY 4 AND MARCH 14, 1913.

| RANGE OF LOADING | Total number of passengers | Per cent of total passengers | Number of cars | Per cent of total cars |
|---|---|---|---|---|
| 110–119 | 220 | 9.2 | 2 | 7.2 |
| 100–109 | 618 | 26.1 | 6 | 21.3 |
| 90– 99 | 560 | 23.4 | 6 | 21.5 |
| 80– 89 | 509 | 21.3 | 6 | 21.5 |
| 70– 79 | 220 | 9.2 | 3 | 10.7 |
| 60– 69 | 122 | 5.2 | 2 | 7.1 |
| 50– 59 | ........ | ........ | ........ | ........ |
| 40– 49 | 137 | 5.6 | 3 | 10.7 |
| 0– 39 | ........ | ........ | ........ | ........ |
| Totals | 2,386 | 100.0 | 28 | 100.0 |

SUMMARY BY DAYS

| | Total passengers | Total cars | Average load |
|---|---|---|---|
| Wednesday, January 29 | 774 | 11 | 70 |
| Thursday, February 4 | 811 | 9 | 90 |
| Friday, March 14 | 801 | 8 | 100 |
| Total | 2,386 | 28 | 82 |

The data contained in Table XXXII may be shown graphically as in Fig. 28.

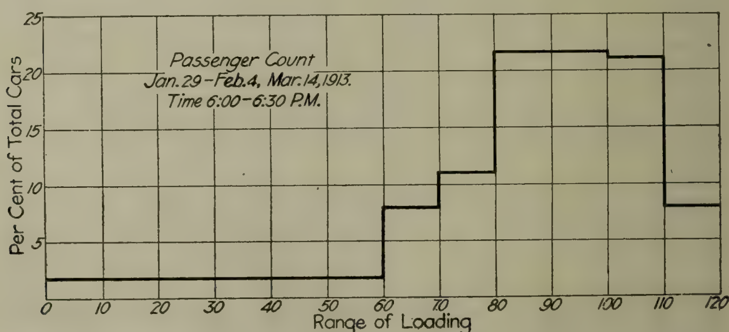



FIG. 28. PERCENTAGE OF CARS FOR EACH LOADING RANGE — A TYPICAL LINE

With a given number of cars in any defined period the loading as between cars will depend upon two things:

(1) The scheduled distribution of cars.
(2) The rate at which passengers originate.

These two factors, as actually observed, result in a third, viz.:

(3) The distribution of cars.

In an ideal distribution the cars would be so spaced as to produce the average load on each car. It is not practicable to so operate cars as to attain this end.

The overloading might be reduced by eliminating the causes resulting in the distortion of headway. Not all causes of distortion can be eliminated since some, such as railroad crossings, are beyond the control of the utility. Others, such as limiting the number of passengers on a car, would cause discontent among prospective passengers.

TABLE XXXIII — CAPACITY OF CARS

| TYPE | Number of seats | Area standing space | Number standing (4 sq. ft. per person) | Total capacity | Actual number standing | Total number | Area per person |
|---|---|---|---|---|---|---|---|
| | | *(sq. ft.)* | | | | | *(sq. ft.)* |
| Rebuilt car.......... | 42 | 148 | 37 | 79 | 51 | 93 | 2.9 |
| 500 series........... | 52 | 200 | 50 | 102 | 67 | 119 | 2.98 |
| 600 series........... | 52 | 180 | 45 | 97 | 76 | 128 | 2.37 |

The problem of determining a standard of loading involves a consideration of many factors, among which are:

(*a*) Number of seats and their arrangement.
(*b*) Area of free standing space.
(*c*) Arrangement of bulkhead doors.
(*d*) Type of steps as fixed or folding.
(*e*) Practice as to passing of conductor through car to collect fares.
(*f*) Number and location of doors by which passengers enter and leave car.
(*g*) Distribution of standing passengers throughout car.
(*h*) Comfort of passengers which depends on:

(1) Length of ride.
(2) Relative proportion of pasengers boarding and alighting from cars.
(3) Proximity of passengers to beginning of discharging area.
(4) Weather conditions.

(5) Social and industrial classes to which passengers belong.
(6) Heating and ventilation of car.
(7) Type of seat and seat spacing.

Eliminating from consideration items (*d*) to (*h*), both inclusive, we find for the various types of cars operated in the City of Milwaukee the factors, as shown in Table XXXIII.

The effect of the bulkhead doors and partition on the 500 series car in reducing the observed standing capacity is shown by the increase in area per person required in that type of car as compared with the two other types.

The ratio of the capacities on the two bases to the number of seats is shown in Table XXXIV.

Table XXXIV — Relative Capacity of Cars

| Type | Number of seats | Per cent of total number, based on 4 sq. ft. | Per cent of total number, actual load | Mean per cent |
|---|---|---|---|---|
| Rebuilt | 42 | 188 | 221 | 204.5 |
| 500 series | 52 | 196 | 229 | 212.5 |
| 600 series | 52 | 186 | 246 | 216.0 |
| Mean | ........ | 190 | 232 | 211.0 |

Since both the seating capacity and standing capacity of cars vary for the different types, it is important to base the standard of loading on the number of seats, or some function thereof. If the standing passengers be determined by the "four square feet per person" rule the average capacity is 190 per cent of the seats. If the maximum number of standing passengers be used, the average capacity is 232 per cent of the seats.

The latter figure of 232 per cent of the seats would result in a crowded car. It is undesirable to use any factor as large as this in the design of schedules since some "factor of safety" is required to allow for unusual conditions arising in every well operated system.

The rule of four square feet per passenger gives ample room for one to pass through the car with considerable freedom. This capacity may at times be exceeded up to 232 per cent and in exceptional instances even the latter figure will be exceeded.

It accordingly appears that a loading equivalent to 190 or 200 per cent of the seating capacity is not uncomfortable. Using the lesser figure of this range, it may be stated that rush hour schedules using the types of cars referred to, shall be designed on the basis of 100 seats for every 190 passengers.

The next matter of importance in designing schedules for rush hour service is that of the length of period over which the number of passengers shall be measured for the purpose of applying the standard loading factor. If the number of passengers during the period 6:00 to 6:15 be greater than the number between 6:15 and 6:30, it is readily evident that the average number per minute for the half-hour period 6:00 to 6:30 will be less than the rate of flow for the period 6:00 to 6:15 and greater than the period 6:15 to 6:30.

Where the cars are being operated on short headway, a shorter period may be used than in case of longer headway since there are more cars upon which to base average loading than in the latter case. If the headway were 30 minutes a half-hour period would obviously have to be used. If the headway were 15 minutes independent of the loading, the results for the 15 minutes and half-hour periods would be the same.

Observation shows that the rate of passenger flow varies as between different hours of the same day and different periods of the same hour. The transportation of passengers in groups contained in each car requires that their rate of flow be integrated across a definite period of time and sufficient cars be allowed to that period to carry the passengers without discomfort.

From the standpoints of comfortable passengers and economical operation the car capacity curve should fit as closely as practicable, the passenger demand curve. Cars on a given line must necessarily be run with some intended regular spacing between them, because they as a rule use some track in common with other cars which have similar functions. The passenger demand curve will show variations from day to day and season to season. Schedules may be temporarily modified to suit weather conditions, but it is practically impossible to secure a 100 per cent closeness of fit between passenger demand and car capacity. The shorter the period of time chosen, the closer will be the fit. The shortest practicable period of time on lines having a short headway seems to be 15 minutes under normal conditions. As the headway increases the period should be lengthened to from 30 to 60 minutes.

Table XXXV — Observations Made

| Line | Points | Number of days |
|---|---|---|
| 1 | a | 10 |
| 2 | b | 7 |
| 3 | c | 4 |
| 4 | d | 4 |
| 5 | e | 10 |

It has been proposed to derive the comfortable car capacity by a factor determined as the ratio of the average to the maximum loading in order to determine the car capacity required.

A series of observations were made as indicated by Table XXXV. These extended over the period 3:30 to 6:30 p. m.

By using the average value of the "ratio of average to maximum loading" the figures shown in Table XXXVI are obtained:

TABLE XXXVI — DIVERSITY OF LOADING

| Period | Ratio maximum load to average load |
|---|---|
| | *Per cent* |
| 5:30 to 5:45 P. M. | 144 |
| 5:45 to 6:00 P. M. | 139 |
| 6:00 to 6:15 P. M. | 136 |
| 6:15 to 6:30 P. M. | 146 |

Then choosing the period 5:45 to 6:15 as that of the heaviest loading, a mean figure for this period of 137 per cent is derived. Of these observations about two-thirds show ratios in excess of 120 per cent on account of high maximum and the other one-third show ratios in excess of 120 per cent on account of low averages.

It appears that both high maximum and low averages contribute to produce a high ratio of maximum to average. That is, both few and many cars result in a high ratio.

The use of a single observation to determine car loading gives underweight to unusual loads or works a hardship should the cars be operated at too light a load.

Ratios of the kind referred to do not show the overloading of the cars much more than they show underloading.

The use of a single observation or the average of a number of single observations for determining schedules is analogous to the use of a short circuit or very heavy overload in determining the load on an electrical generator. In this latter case the necessity of using a figure determined as the output over a definite period of time is now well recognized. Instantaneous overloads do not measure the maximum load factor or the machine capacity to be provided.

If such a ratio of maximum to average as 137 per cent be used and applied to a maximum car loading of 190 per cent there results an average loading during the assumed period of 138.6 per cent of the seating capacity.

The difficulties associated with the use of instantaneous or individual

ratios can be obviated if consideration be given to the loading of cars and the number of passengers carried at each loading.

Table XXXVII shows the summary of observations on three different lines and three different days during the period 6:00 to 6:30 p. m.

TABLE XXXVII — SUMMARY OF OBSERVATIONS

| RANGE OF LOADING | Passengers | Per cent of total passengers | Average load per car | Total cars | Per cent of total cars |
|---|---|---|---|---|---|
| 110–119 | 220 | 2.23 | 110.0 | 2 | 1.4 |
| 100–109 | 1,438 | 14.61 | 102.7 | 14 | 10.2 |
| 90– 99 | 2,587 | 26.26 | 92.5 | 28 | 20.5 |
| 80– 89 | 1,768 | 17.95 | 84.2 | 21 | 15.3 |
| 70– 79 | 1,165 | 11.84 | 77.7 | 15 | 11.0 |
| 60– 69 | 993 | 10.09 | 62.1 | 16 | 11.7 |
| 50– 59 | 922 | 9.37 | 54.2 | 17 | 12.4 |
| 40– 49 | 355 | 3.61 | 50.7 | 7 | 5.1 |
| 00– 39 | 394 | 4.04 | 23.2 | 17 | 12.4 |
| Total | 9,842 | 100.00 | 71.8 | 137 | 100.00 |

A graphical representation of the distribution of passengers among cars is shown in Fig. 29.

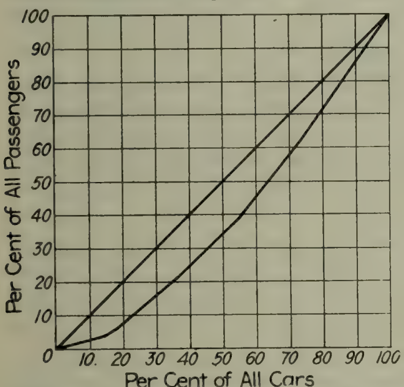



FIG. 29. DISTRIBUTION OF PASSENGERS AMONG CARS

It would have been better if the range of loading had been measured as a function of seating capacity rather than in range of passengers. This would have eliminated the effect of varying car sizes.

If the average car be assumed to contain 45 seats the maximum rush hour capacity of 190 per cent of this is 86. It appears from Table XXXVII that 43.1 per cent of the total passengers were carried in 32.1 per cent of the cars.

If the average loading of 71.8 passengers on 137 cars be associated with the average of the two highest cars or 110, the ratio of maximum to average is 153.2 per cent. This figure, it is evident, differs materially from the 137 per cent derived in another manner. It seems safe to conclude that ratios of this kind do not convey any quantitative meaning and have a very limited application, if any at all, to schedule designing.

Examining the range 90 to 119 for the separate lines we find the relations shown in Table XXXVIII.

Table XXXVIII — Percentage of Passengers by Groups of Loading

| Range | 3 lines combined | | Line 4 | | Line 5 | | Line 3 | |
|---|---|---|---|---|---|---|---|---|
| | Number of passengers | Per cent of total | Number of passengers | Per cent of total | Number of passengers | Per cent of total | Number of passengers | Per cent of total |
| 110–119 | 220 | 2.23 | ....... | ....... | 220 | 9.2 | ....... | ....... |
| 100–109 | 1,438 | 14.64 | 205 | 7.0 | 618 | 26.1 | 615 | 13.5 |
| 90– 99 | 2,587 | 26.26 | 917 | 31.4 | 560 | 23.4 | 1,110 | 24.5 |
| 90–119 | 4,245 | 43.13 | 1,122 | 38.4 | 1,408 | 58.7 | 1,725 | 38.0 |
| Average load per car in range 90–119 | 96.5 | ....... | 93.8 | ....... | 100.6 | ....... | 95.9 | 66 |
| Average load per car in range 0–119 | 71.8 | ....... | 75.0 | ....... | 82.0 | ....... | 63.8 | ....... |

Making a comparison of the three lines, it appears that Line 5 is the heaviest loaded of the three. It shows the greatest average load per car, the greatest individual loading per car and shows 58.7 per cent of its passengers within the range "90–119." The other two lines show about 38 per cent of their passengers within the range "90–119" and an average load much less than that on Line 5.

Comparing Lines 4 and 3, it appears that the former has better characteristics than the latter, in that the cars present a more uniform loading. In other words the passengers are more uniformly distributed among the cars. This is also evident from an examination of the original data. These show further that the cars are maintained on a more uniform headway on Line 4.

In fact it appears that uniformity of headway is more important than additional cars in reducing maximum loading. In the case of Line 3 the maximum loading could have been reduced and the average loading increased by a better distribution of cars and the use of fewer of them.

A rule for loading that will secure more uniformity and better distribution is much to be desired. Such a rule cannot be derived by the application of the 137 per cent "maximum to average" factor to the maximum car loading since it does nothing to encourage uniform distribution of loading.

Any rule for loading must possess the following properties:

(1) It must provide for the exceptional conditions as well as for the normal conditions.

(2) It must be definite so as to permit its application in schedule making and checking up in practice.

(3) It must encourage uniform loading of cars and maintenance of proper headway to insure such loading.

(4) It must provide for a not uncomfortable load at all times, except where an abnormal disturbance occurs.

In an attempt to determine the outlines of this rule we shall plot the "polygon of loaded ordinates" as a graphic illustration of the statistical groupings. The resultant polygon is shown in heavy lines in Fig. 30. In simplifying the shape of this polygon the angular points have been cut off by straight lines (Fig. 31), and there results a six-

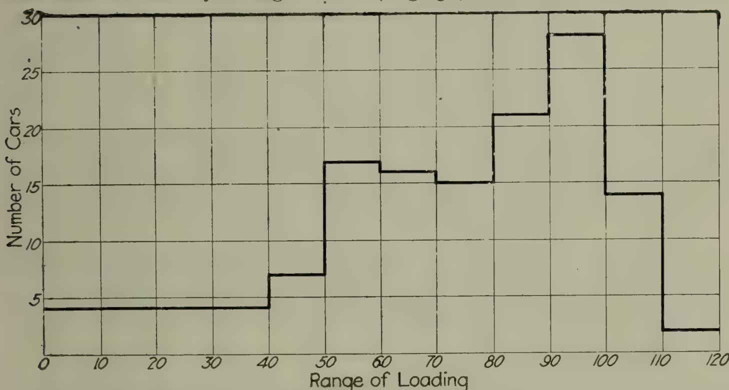



FIG. 30. PERCENTAGE OF CARS FOR EACH LOADING RANGE — COMBINED DATA — LINES 3, 4 AND 5, OBSERVED FROM 6:00 TO 6:30 P. M. AT POINT OF MAXIMUM LOADING.

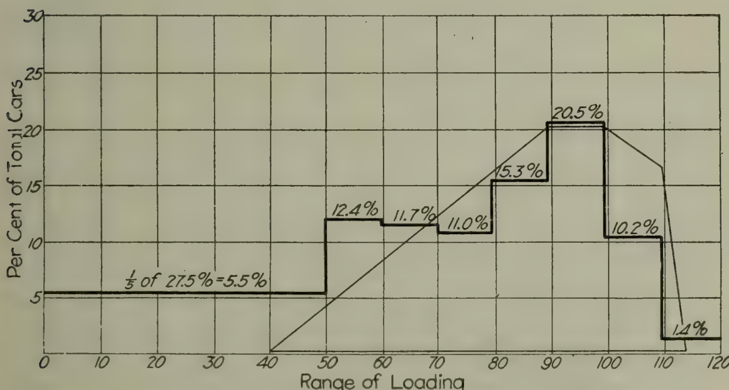



FIG. 31. SMOOTHED CURVE INDICATING PERCENTAGES OF CARS FOR EACH LOADING RANGE — COMBINED DATA — LINES 3, 4 AND 5, OBSERVED FROM 6:00 TO 6:30 P. M. AT POINT OF MAXIMUM LOADING.

sided figure. There has thus been derived a new polygon of loaded ordinates nearest approximating the straight lines. This results in a frequency distribution as shown in Table XXXIX.

Table XXXIX — Frequency Distribution of Loading

| Grouping | Per cent derived normal frequency | Per cent of total | Per cent observed frequency |
|---|---|---|---|
| 0– 49 | 3.47 | 2.6 | 17.5 |
| 50– 59 | 9.01 | 17.7 | 12.4 |
| 60– 69 | 12.03 | 15.4 | 11.7 |
| 70– 79 | 15.79 | 15.4 | 11.0 |
| 80– 89 | 18.80 | 17.8 | 15.3 |
| 90– 99 | 20.30 | 26.0 | 20.5 |
| 100–109 | 18.80 | 5.1 | 10.2 |
| 110–119 | 1.51 | 0 | 1.4 |

If we now convert the loading groups into percentage of seating capacity, using maximum comfortable loading at 190 per cent of 52, or 99, the results are as shown in Table XL.

Table XL — Frequency Distribution of Loadings in Per Cent of Seating Capacity

| Per Cent Seating Capacity | Normal frequency of cars in per cent of total |
|---|---|
| 0– 95 | 3.74 |
| 96–114 | 9.01 |
| 115–133 | 12.03 |
| 134–152 | 15.79 |
| 153–171 | 18.80 |
| 172–190 | 20.30 |
| 191–209 | 18.80 |
| 210–228 | 1.51 |

The average loading during the period taken is 158 per cent of the seating capacity. If now we recast the table and apply the loading rule, the result is that shown in Table XLI.

Lower ranges of loading are not specified as they are subject to wider variation in practice than can be permitted in higher loadings.

For application to individual lines the following rule may be stated.

The utility shall operate a sufficient number of cars of such capacity

TABLE XLI — PERMITTED FREQUENCY OF DIFFERENT LOADINGS (AS DERIVED)

| LOAD ON CARS MEASURED IN PER CENT OF SEATING CAPACITY | Maximum number of cars which shall be permitted to carry specified loading. Per cent of total |
|---|---|
| 210 and over | 1.51 |
| 191 and over | 20.31 |
| 172 and over | 50.61 |
| 153 and over | 69.41 |
| 134 and over | 85.20 |

as it has available and in such order as it may determine during the rush hour periods, so that the percentage of cars carrying the designated loadings shall not be greater than that specified in Table XLII.

TABLE XLII — PERMITTED FREQUENCY OF DIFFERENT LOADINGS (AS CORRECTED)

| LOAD OF CARS MEASURED IN PER CENT OF SEATING CAPACITY | Maximum number of cars which are permitted to carry specified loading |
|---|---|
| | (*Per cent*) |
| 191 and over | 22 |
| 172 and over | 40 |
| 153 and over | 60 |
| 134 and over | 75 |

The rule shown in graphic form is indicated in Fig. 32.

Standards of reasonable public service must prove sufficiently flexible to meet a variety of conditions when prescribing definitely the line of demarcation between poor service and reasonably adequate service. The Wisconsin Railroad Commission has recognized this in prescribed standards for gas, electric and telephone service. It is obvious that because of ever-changing conditions of operation, standards similar in form must be developed for street railway service.

Standards for street railway service must recognize the fact that the human element with its chance of occasional mishap predominates. It is evident that no rule can prevent the occasional overcrowded car. The service rule may provide, however, that abnormal conditions

be reduced to a reasonable minimum. Street railway service is here analogous to telephone service, for which the Commission has indicated the allowable variation from normal conditions.

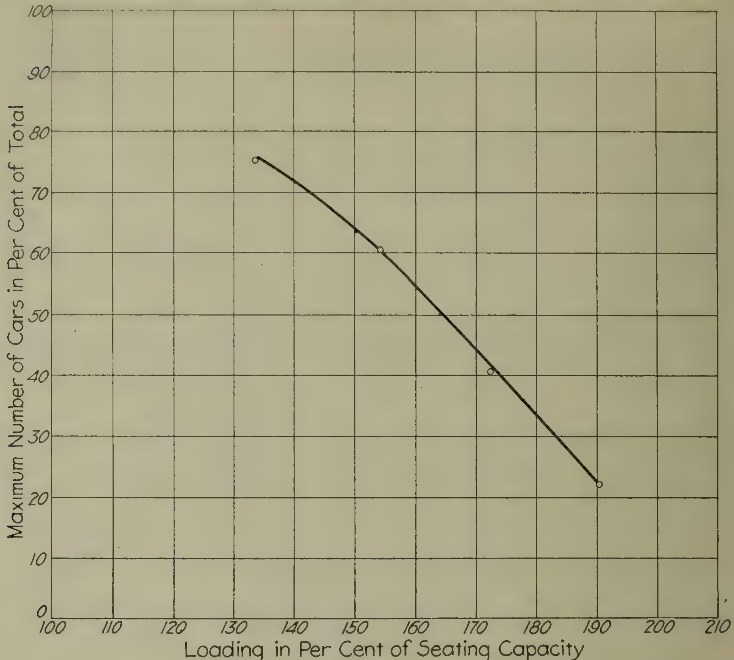



FIG. 32. CURVE SHOWING PROPOSED RULE FOR CAR LOADING.

What constitutes such a reasonable variation from normal must be based upon experience. Obviously it should not be reduced so low as to be impossible of fulfillment.

The number of cars which will insure such reasonable standard of service with a limited variation from normal cannot be prescribed, any more definitely than it is possible to prescribe the number of telephone operators necessary to furnish a stipulated promptness of service. It is evident from a study of the variation from normal, or diversity that obtains upon the various typical lines herein referred to, that no statistical coefficient of relation of average, median or mode to maximum, or of a determined standard deviation can apply to all cases and yield similar results. Such a fixed relation between certain characteristics of the frequency curve can only be established where the variations from normal are identical.

The period over which the standard rule of minimum variation from normal should be applied, must conform to the entire period under observation.

# CHAPTER XII

## PRESCRIBED STANDARDS OF SERVICE

Regulation of Service,—— Methods of Defining Adequate Service,—— Prescribed Standards,—— New York,——Milwaukee,—— St. Louis,—— Chicago,—— Variation in Prescribed Standards,—— Recommended Standards,—— Chicago,—— Philadelphia,—— Pittsburgh,—— St. Louis,—— San Francisco,—— Kansas City,—— Providence,—— Cincinnati,—— Winnipeg,—— Difficulty in Formulating Standards,—— Diversity,—— Car Capacities,—— Variation of Passenger Demand,—— Cost of Service,—— Practical Aspects of Complying With Service Standards,—— General Conclusions.

In the three preceding chapters, there has been discussed in some detail the problem of determining the relation between service and traffic. In the present chapter, there will be set forth some of the standards of service which have been proposed and adopted by various bodies exercising regulatory powers over street railways.

Regulation of street railways has been exercised in varying degrees at all times since the beginning of the industry. Originally, such limitations as were placed upon operation were contained in the provisions of franchise ordinances, but there has been, since 1907, a gradual assumption by state governments of the exercise of such control.

In general, the obligations of street railways to render service are defined by the words "reasonably adequate" and "safe." Just what adequate service will comprise, how it may be prescribed and measured, are problems which have of late played a prominent part in the work of regulating commissions. The problem is still far from being satisfactorily solved, judging from the changes in orders which have been found necessary. This has been due principally to lack of recognition of the physical and operating conditions under which service must be furnished and the peculiarities of the demand for public service. One of the unknown factors also which have been given little recognition is the consideration of what is comfortable service, or the psychological aspect, which is discussed in the following chapter. A very definite factor, on the other hand, which has not been given sufficient recognition is the financial ability of the company to comply with the standard prescribed.

Regulatory bodies have endeavored to insure adequate service by various methods. The most frequent method of defining reasonably adequate service at the present time is by means of rules setting forth what are judged to be reasonable ratios between the number of seats and the number of passengers. It has also been attempted to define reasonable service by prescribing the number of cars which must operate past given points during definite periods of time and by prescribing the number of car miles which must be run within a given area at different times of the day. Such rules as the foregoing have been modified by permitting different seat ratios during rush

and non-rush periods and by variously defining what shall be considered comfortable standing space in different types of cars.

In the following paragraphs, there are set forth service standards which have been promulgated at different times in four of the larger cities in the United States and it will be observed that not only is there wide variation between the methods employed by the regulatory bodies in defining adequate service but also that the same body may find it necessary from time to time to revise its original rules.

## New York

SURFACE LINES:

Since its organization in 1907, the Public Service Commission for the First District of New York has issued various rulings concerning standards of service.[1] One of the early orders issued December 27, 1907, governed the service on the Eighth Avenue line. This order was based upon the following opinion quoted here in part:

During the hours between midnight and six in the morning, the operating schedule of the company calls for a twenty minute headway most of the time. Although this schedule has been sufficient to give every passenger a seat, in my opinion such a service is not adequate for the district above Thirteenth Street. Persons ought not to be required to wait twenty minutes upon a street corner, especially during the winter, for a car to take them home. If there were stations or some sort of structures to protect persons from the inclemency of the weather, it might be inadvisable to require more cars to be run, but in view of the present circumstances, I have recommended that at least six cars an hour be run, reducing the headway from twenty to ten minutes, above Thirteenth Street. Below Thirteenth Street the district is almost wholly a business district and the traffic is so very light during the night that it does not seem reasonable to require an increased service even though the present schedule calls for a twenty minute headway.[2]

The following paragraphs specifying how service should be furnished are quoted from the order.[3]

1. By running south from One Hundred and Forty-ninth Street, daily except Sundays, cars as follows:

Between 7 a. m. and 10 a. m. not less than one hundred and ten (110) cars, to run at least as far south as Thirteenth Street.

Between 6:30 p. m. and 8:30 p. m. not less than seventy (70) cars, to run at least as far south as Thirteenth Street.

2. By running north from Thirteenth Street, daily except on Sunday, cars as follows:

Between 4:30 p. m. and 6:30 p. m. not less than one hundred and thirty (130) cars, to run at least as far north as One Hundred and Forty-ninth Street.

---

[1] It must not be assumed that the quotations from the opinions of the First District Commission of New York are complete or final. The multiplicity of rehearings and consequent modifications make this an unnecessary task since only the method of attacking the problem, the point of view of the regulatory body, and the substance of the orders is of interest in this connection.

[2] Public Service Commission, First District of New York, 1907 Report, page 84, vol. I.

[3] Public Service Commission, First District of New York, 1907 Report, page 751, vol. I.

3. By running on Sundays, south from One Hundred and Forty-ninth Street, cars as follows:

Between 10:00 a. m. and 11:30 p. m. not less than six hundred (600) cars, to run at least as far south as Thirteenth Street.

4. By running not less than six (6) cars in each hour of the night and morning, daily and Sundays, from Thirteenth Street north to One Hundred and Forty-ninth Street, and from One Hundred and Forty-ninth Street south at least to Thirteenth Street, the cars to be as evenly distributed as possible, in each hour.

The order of December 27, 1907, was modified May 12, 1908, by the adoption of a more elastic standard of service as indicated by the following paragraphs:

1. By operating daily, including Sundays over every point of the Eighth Avenue line between Thirteenth Street and the northerly terminus of the line either

(*a*) A sufficient number of cars in each direction past any point of observation to provide during every fifteen minute period of the day and night a number of seats at least ten (10) per cent in excess of the number of passengers at that point; the number of cars passing any point to be, however, never less than six (6) per hour in each direction; or

(*b*) A minimum number of twenty-five (25) cars in one direction in each fifteen (15) minute period in which the provisions of subdivision (*a*) above are not complied with.[1]

On April 17, 1908, a similar provision had been made effective for the Third and Amsterdam Avenue line. This order read in part as follows:

**Third and Amsterdam Avenue Line:**

(*a*) A sufficient number of cars in each direction past any point of observation to provide during every fifteen (15) minute period of the day or night a number of seats at least ten (10) per cent in excess of the number of passengers at that point, the number of cars passing any point to be, however, never less than six (6) per hour in each direction, or

(*b*) Over that portion of the above described line south of Sixth Street, a minimum number of twelve (12) cars in one direction in each fifteen (15) minute period in which the provisions of subdivision (*a*) above are not complied with; and over that portion of the line above described north from Sixth Street, a minimum number of twenty-five (25) cars in one direction in each fifteen (15) minute period in which the provisions of subdivision (*a*) above are not complied with.[2]

In an opinion rendered on the above date, with regard to service on the Twenty-third Street Crosstown line, Commissioner Maltbie wrote as follows:

**Twenty-third Street Crosstown Line:**

* * * The requirement that a certain number of cars must be run during certain hours has been found to be too rigid and not suffi-

---

[1] Public Service Commission, First District of New York, 1908 Report, vol. II, page 478.

[2] Public Service Commission, First District of New York, 1908 Report, vol. II page 495.

ciently elastic for certain surface lines. Consequently, the order directed to be drawn in the present case provides that the number of seats in the cars passing any point of observation upon the Twenty-third street line shall exceed by at least 10 per cent the number of passengers in those cars, but never less than six per hour, or if it is impossible to comply with this provision, that at least twenty-five cars shall pass such point of observation within every fifteen minute period.

The purpose of this order is to give every one a seat, and a 10 per cent excess of seats over passengers has been required because of the irregularity of traffic and of cars. If the cars were to run with absolute regularity and if passengers were to board these cars at regular intervals and at equidistant points, it might not be necessary to provide a greater number of seats than passengers, but cars do not run regularly and passengers do not board the cars with absolute uniformity, and it has been found, as a matter of practical observation, that in order to provide seats for all passengers, it is necessary to run cars with a greater seating capacity than the number of passengers. Whether a 10 per cent excess is sufficient to accomplish this result cannot be determined without experiment, and it is possible that after a trial has been had it will be necessary either to increase or decrease the percentage of excess suggested.[1]

On February 9, 1909, service was prescribed on the Fourteenth Street Crosstown line in an opinion rendered by Commissioner Maltbie as follows:

**Fourteenth Street Crosstown Line:**

Owing to general traffic conditions at various points upon this line, it is not possible to operate a sufficient number of cars to give every passenger a seat, but the order requires as many cars to be run during rush hours as can be operated regularly. At other times, the number of seats shall at least equal the number of passengers in every fifteen minute interval. Certain points of observation are fixed, so that the Commission and the receivers may determine at any time whether the order is being obeyed.[2]

The following paragraphs are quoted from the subsequent order of the Commission adopted after rehearing:

By operating daily, including Sunday, eastbound and westbound on Marginal Street past the intersection of Thirteenth Street, on Fourteenth Street past the intersection of Eighth Avenue, on Fourteenth Street at the intersection of Avenue A and on Delancey Street at the westerly end of the Williamsburg Bridge in each fifteen (15) minute period, either

(*a*) A sufficient number of cars in each direction at all hours of the day and night to provide at each of the points named above, a number of seats at least equal to the number of passengers at such points; the number of cars passing each of the points named to be, however, never less than six (6) per hour in each direction; or

(*b*) From April 5, to May 1, 1909, a minimum number of twenty-two (22) cars during the morning hours and twenty-five (25) cars during the evening hours in one direction past each of the points

[1] Public Service Commission, First District of New York, 1908 Report, Vol. II, page 472.

[2] Public Service Commission, First District of New York, 1909 Report, vol. II, page 347.

named above and on and after May 1, 1909, a minimum number of twenty-two (22) cars during the morning hours and thirty (30) cars during the evening hours in one direction past each of the points named above.

*Further Ordered,* That on Monday of each week the said Metropolitan Street Railway Company, and said Adrian H. Joline and Douglas Robinson, as its Receivers, give to the Public Service Commission for the First District, notice in writing, showing the maximum number of cars actually in service on the Fourteenth Street and Williamsburg Bridge line to Brooklyn at any one time in the morning and in the afternoon, the length of time this maximum car service was maintained.[1]

SUBWAY AND ELEVATED LINES:

One of the first things considered by the Commission after its organization was the service during rush hours upon the subway and elevated lines. On October 9, 1907, an order was issued from which the following is quoted:[2]

That the service of the Interborough Rapid Transit Company upon the lines, at the point and at the times hereinafter set forth, except on Saturday afternoons, Sundays and holidays, be increased in the particulars and by the means hereinafter stated as follows, to-wit:

**Subway Express:**

1. Southbound, at Grand Central station, from 7:00 to 7:30 a. m., by an increase of 16 cars, rendered by 2 trains from West Farms, upon said line.
2. Southbound, at Grand Central station, from 8:30 to 9:00 a. m., by an increase of 8 cars, rendered by 1 train from West Farms, upon said line.
3. Northbound, at Fourteenth Street station, from 5:00 to 5:30 p. m., by an increase of 8 cars, rendered by 1 train to West Farms, upon said line.
4. Northbound, at Fourteenth Street station, from 6:30 to 6:45 p. m., by an increase of 8 cars, rendered by 1 train to West Farms, upon said line.

**Sixth Avenue Elevated:**

1. Southbound, at Fiftieth Street station, from 7:30 to 9:00 a. m., by an increase of 28 cars, to the trains from Harlem.
2. Northbound, at Fiftieth Street station from 5:00 to 6:30 p. m., by an increase of 33 cars to the Harlem trains.

The above order contained similar provisions for the Second, Third and Ninth Avenue elevated lines. The order governing the service on the Sixth Avenue elevated line was modified on December 11, 1908, to read as follows:[3]

Now, it being made to appear after the proceedings upon the said hearing that at or about the time of the issuing of said order of December 11, 1907, the said Interborough Rapid Transit Company added three 6-car trains and four 7-car trains to its southbound service

[1] Public Service Commission, First District of New York, 1909 Report, vol. II, page 347.

[2] Public Service Commission, First District of New York, 1907 Report, vol. I pages 697, 698, 699.

[3] Public Service Commission, First District of New York, 1908 Report, vol. II pages 447 and 448.

on its Sixth Avenue line from Harlem, and added four 7-car trains to the north-bound service on its Sixth Avenue line to Harlem; and it appearing that at a result of such increase the Harlem service of the Interborough Rapid Transit Company in the transportation of persons on its Sixth Avenue line in the First District has been and is at the points and at the times set forth as follows:

*Passing Fiftieth Street, Southbound.*

7:00 a. m. to 7:30 a. m., 9 seven-car trains from Harlem;
7:30 to 8:00 a. m., 11 seven-car trains from Harlem;
3 six-car trains from Harlem;
8:00 a. m. to 8:30 a. m., 11 seven-car trains from Harlem;
8:30 a. m. to 9:00 a. m., 10 seven-car trains from Harlem.

*Passing Fifieth Street, Northbound.*

4:30 p. m. to 5:00 p. m., 9 seven-car trains to Harlem;
5:00 p. m., to 5:30 p. m., 11 seven-car trains to Harlem;
5:30 p. m., to 6:00 p. m., 13 seven-car trains to Harlem;
6:00 p. m., to 6:30 p. m., 14 seven-car trains to Harlem;
6:30 p. m., to 7:00 p. m., 12 seven-car trains to Harlem,

and it appearing further that it is just, reasonable and proper that said Interborough Rapid Transit Company should maintain said service on its Sixth Avenue line as thus increased and supplemented, and that said increase of service is necessary and reasonable to accommodate passenger traffic transported by said company or offered for transportation to it at the times hereinbefore specified;

Therefore, on motion duly made and seconded, it is

*Ordered,* That said Interborough Rapid Transit Company operate its trains on its said Sixth Avenue line with not fewer trains and not fewer cars on the routes and at the times hereinbefore specified in the schedule of its service as increased and supplemented, and it is * * *

On the Broadway and Lexington Avenue elevated lines in Brooklyn, adequate service was discussed February 2, 1909, in an opinion by Commissioner Bassett, in the following language:[1]

* * * The general object has been to cause an operation that will come as near to giving a seat to every passenger as is practicable. The reason why this ideal cannot be attained is because in the rush hours enough trains cannot be sent across the two tracks on Brooklyn Bridge to seat every passenger. * * * The general object of these orders may be stated as follows: To cause a maximum proportional service during rush hours over the points of restricted capacity, to cause a maximum operation of short line trains in rush hours, and to operate in non-rush hours an average of as many seats as there are passengers. It is impracticable to require that every train in non-rush hours shall have seats enough for all passengers because unavoidable delays will always cause an occasional train to take more than its share of waiting passengers, and the arrival of large numbers of people, as from theatres, will at times crowd any train. The requirement is that a waiting passenger must be able to get a seat in non-rush hours by waiting four trains when the scheduled headway is five minutes, by waiting three trains when the scheduled headway is ten minutes, by waiting for two trains when the scheduled headway is fifteen minutes.

---

[1] Public Service Commission, First District of New York, 1909 Report, vol. II, page 320.

This opinion was approved by the Commission, which thereupon issued the order from which the following paragraphs are taken:[1]

*Ordered,* That the Brooklyn Union Elevated Railroad Company provide daily, including Sundays, a reasonable and adequate service in each direction past every point on its Broadway Elevated line by operating the said line in accordance with the following requirements, so as to furnish either seats for all passengers or the maximum service that the physical condition of the tracks will permit:

*First,* On Sundays and holidays between 7:00 a. m. and 11:00 p. m., the scheduled headway between trains being operated shall not be greater than ten minutes at any point between Delancey Street terminal and Canarsie terminal. On other days between 6:30 a. m. and 11:00 p. m., the scheduled headway shall not be greater than ten minutes at any point between Eastern Parkway station and Delancey Street terminal and not greater than fifteen minutes at any point between Eastern Parkway and Canarsie terminal. At all other times the scheduled headway between trains being operated shall not be greater than thirty minutes at any point between Delancey Street terminal and Canarsie terminal.

*Second.* During all hours daily, service shall be provided past any point between the Delancey Street terminal, Manhattan, and Canarsie terminal, Brooklyn, in one or other of the two following manners:

1. A sufficient number of cars shall be operated on all trains to provide a number of seats at least equal to the number of passengers as follows:

(*a*) On every four consecutive trains past such point when the scheduled headway between the trains being operated does not exceed five minutes.

(*b*) On every three consecutive trains past such point when the scheduled headway between the trains being operated is more than five but not more than ten minutes.

(*c*) On every two consecutive trains past such point when the scheduled headway between the trains being operated is more than ten but not more than twenty minutes.

(*d*) On each train past such point when the scheduled headway between the trains being operated is more than twenty minutes; or

2. Trains of six cars each shall be operated past such point on a schedule which provides for the operation of trains over the tracks of the said Broadway line between Lexington Avenue and Pitkin Avenue at a minimum rate of twenty-one trains in thirty minutes on all lines of the said Brooklyn Union Elevated Railroad Company operating over the said portion of the Broadway line tracks.

On December 28, 1910, reasonable service on the Subway Lines was designated thus:[2]

*Ordered,* (1) That on and after December 28, 1910, the said Interborough Rapid Transit Company shall operate daily, including Sundays and holidays on all subway express and local tracks in each direction past every station during all hours of the day and night in each fifteen minute period, beginning on the even hour, quarter past the hour, half past the hour and quarter of the hour,

(*a*) A sufficient number of trains and cars to provide a number of seats at least equal to the number of passengers, or

[1] Public Service Commission, First District of New York, 1909 Report, vol. II, page 322.

[2] Public Service Commission, First District of New York, 1910 Report, vol. page 174.

(*b*) The maximum number of trains and cars that can be operated.

On March 1, 1915, Commissioner of Health Goldwater issued an order limiting the number of passengers to 150 per cent of the seating capacity of the cars on the Fifty-ninth and Eighty-sixth Street cross-town lines. Commissioner Goldwater said in part:

The order issued by this department, largely because of its unprecedented character, has aroused varied comment and has given rise to some misunderstanding. It is to be observed that the order is not general, but relates to specific nuisances which the railroad companies are requested to abate.

The order was later extended to the Graham Avenue line of the Brooklyn Rapid Transit Co., the Eighth and Sixth Avenue car lines of the New York Railways Co., the Staten Island car lines and finally to the Subway Division of the Interborough Rapid Transit Co.[1] At the same time, the Health Department notified the various companies that failure to obey its orders might result in fines of $250 for each offense or in criminal prosecution of train crews, or both.[2] By coöperation between the Company, the Health Department, and the Police Department, some favorable results in decreasing the variation in loading of consecutive cars were reached.[3]

It will be noted that the early orders of the Commission called for the operation, in a definite direction between fixed points on a line and within a definite period of time, of a fixed number of cars. Moreover, a minimum number of cars per hour was specified. The later orders prescribed a more elastic standard and called for the operation between fixed points on a line of a sufficient number of cars in each direction past any point of observation to provide during every 15-minute period of the day and night, a number of seats at least 10 per cent in excess of the number of passengers at that point. Here again a minimum number of cars per hour was specified. An alternate provision required that a fixed minimum number of cars shall pass a point of observation within every 15-minute period. Still later standards of service orders required the operation during rush hours of as many cars on certain lines as could be operated regularly. At other times, the number of seats,[4] passing fixed observation points in every 15-minute period was to be at least equal to the number of passengers during that period. Orders of a similar character were issued from time to time to govern the operation of subway and elevated lines.

---

[1] This order did not apply to service on the subway division of the Interborough Rapid Transit Company during rush hours.

[2] *Electric Railway Journal* — March 6, 1915; April 10, 1915; May 15, 1915. *New York World*, March 16, 1915.

[3] The order was rescinded in July, 1915.

[4] In July, 1915, the Public Service Commission, First District, New York, established the standard seating space for each passenger to be allowed on the longitudinal seats of surface street railway cars as 17.78 in. This is the average space occupied by each passenger upon such cars according to 800 different cases observed by the Commission' inspectors.

## Milwaukee.

Early orders of the Railroad Commission of Wisconsin attempted to define adequate service in terms of specific headways but on November 25, 1913, an order was issued prescribing standards of car loading and leaving to the company the problem of fitting its service to traffic, in such a way that these standards would be met. This order,[1] which was one of the first service orders in which it was attempted to define accurately the service required, is quoted somewhat at length in the following paragraphs:

1. *Definition of a line.* In the application of the standards of service each line within the limits of the city shall be treated as an independent unit. All lines except crosstown lines shall be considered as terminating in the down-town district.

2. *Rush Periods.* In general, three daily rush periods shall be recognized, namely; morning, mid-day and evening. The morning and evening rush periods may be either inbound or outbound, or both, and the mid-day rush period outbound only; each rush period shall be treated independently.

For the application of standards of service the rush periods shall be designated as follows:

> (*a*) For weekdays including Saturdays, the morning rush period shall be considered to exist for that portion of the day between 6 a. m. and 9 a. m., when the traffic demand in a given direction is distinctly greater than the demand in the same direction for the two hours from 9 a. m. to 11 a. m.
>
> (*b*) For weekdays, Monday to Friday, inclusive, the mid-day rush period shall be the thirty minutes of maximum traffic demand for outbound service taken by fifteen minute periods as hereinafter described whenever this demand is distinctly greater than the demand for outbound service from 10:30 a. m. to 11:30 a. m., or from 12:30 p. m. to 1:30 p. m.
>
> (*c*) For Saturdays the mid-day rush period shall be considered to exist for that portion of the day between 11:30 a. m. and 1:30 p. m., when the traffic demand in a given direction is distinctly greater than the demand in the same direction for the two hours preceding; that is, 9:30 a. m. to 11:30 a. m., or for the three hours following from 1:30 p. m. to 4:30 p. m.
>
> (*d*) For weekdays, including Saturdays, the evening rush period shall be considered to exist for that portion of the day between 4:30 p. m. and 7 p. m., when the traffic demand in a given direction is distinctly greater than the demand in the same direction for the preceding three hours, 1:30 p. m. to 4:30 p. m.

Sundays and all other periods not included in the above specified rush periods shall be considered non-rush periods, except holidays and special occasions when the travel is distinctly greater than normal.

3. *Demand for Service.* The half-hour maximum demand in each rush period shall be used as the basis for the application of the standard of loading for such period, and shall be designated as that half-hourly period beginning on the hour or any fifteen minutes thereafter during which the greatest number of passengers is carried in a given direction. The standard of loading for all other hours of the day shall be applied by half-hourly periods. The half-hourly periods may consist of any two consecutive fifteen minute periods beginning on the hour

---

[1] 13-W. R. C. R.-245.

or any fifteen minutes thereafter. The demand for service for any given half-hour shall be determined separately for week days, Monday to Friday, inclusive, Saturdays and Sundays. The average count of passengers for three consecutive week days, excluding Saturday, shall be considered as the demand for service for week days exclusive of Saturdays. The average count of passengers for three consecutive Sundays shall be considered as the demand for service on Sundays. These averages shall be drawn from the actual count of passengers for corresponding fifteen minute periods during the specified days.

4. *Standards for Service for Non-Rush Periods.* During all non-rush periods a sufficient number of cars shall be operated so that there shall be supplied during any half-hourly period an average of at least 133 seats for each 100 passengers demanding transportation in a given direction at any point on the line, subject to the following exceptions under which all cars are to be operated the full length of the line:

(*a*) Between 6:00 a. m. and 11:00 p. m. cars shall be scheduled to leave the terminals at intervals not to exceed ten minutes, and between 11:00 p. m. and 1:00 a. m. cars shall be scheduled to leave the terminals at intervals not to exceed twenty minutes, unless otherwise specified.

(*b*) The schedule time interval between cars of the Twenty-seventh Street and Thirty-fifth Street, Center Street and North Avenue lines shall not be greater than ten minutes between 6:00 a. m. and such time after 11:00 p. m. as is necessary to make connections with cars on intersecting lines leaving down-town districts at about 11:00 p. m., and thereafter at not greater than twenty minute intervals until such time after 1:00 a. m. as is necessary to make connection with cars on intersecting lines scheduled to leave the down-town district at about 1:00 a. m.

(*c*) Between 6:00 a. m. and 1:00 a. m. twenty minutes shall be the maximum scheduled time between cars operated on the Farwell Avenue line between Mineral road and the down-town district.

Subject also to the following exceptions:

(*d*) No service shall be required on the Twelfth Street Viaduct line during the non-rush hours.

(*e*) Suburban service within the city limits shall not be subject to the standard stated above unless such cars are operated as an integral part of the city schedules.

5. *Standard for Service for Rush Hours.* During the maximum half-hour of any rush period, there shall be supplied an average of at least 67 seats for every 100 passengers demanding transportation in a given direction at any point on the line.

For other half-hours of the same rush period the same actual number of seats shall be supplied as in the maximum half-hour, except that not more than an average of 133 seats shall be required per 100 passengers demanding transportation in any half-hour.

The application of the maximum half-hour standard shall be limited so that the number of seats supplied per half-hour in the morning rush period shall not be less than the number of seats required under the non-rush standard in the same direction for either of the two half-hours immediately following the rush period, and that the number of seats supplied per half-hour in the evening rush period shall not be less than the number of seats required under the non-rush standard in the same direction for either of the two half-hours immediately preceding the rush period.

The number of seats supplied during any half-hour of the mid-day rush shall not be less than the number of seats required under the non-rush standard in the same direction in either of the two half-hours immediately preceding or following the mid-day rush.

During the rush hours, cars to or from Wauwatosa and North Milwaukee which are operated as an integral part of the city schedules shall be preceded at an interval of not more than two minutes by a local car on the same line between the down-town district and the city limits.

6. *Standard for Service for Holidays and Special Occasions.* For holidays and special occasions at such times as the traffic is distinctly greater than normal, the company shall use all reasonable efforts to supply such service as will meet the standard hereinbefore specified for rush periods.

7. *Supervision.* During rush hours, traffic officers with authority over trainmen shall be stationed at important transfer intersections and such other points as will materially assist in the movement of traffic and the maintenance of schedules.

It shall also be the duty of these officers, as far as practicable, to limit the loads on individual cars to the maximum comfortable carrying capacity of the various cars as shown by the following table:

| | Seats | Winter | Seats | Summer |
|---|---|---|---|---|
| Open platform and rebuilt cars | 40 | 70 | 42 | 72 |
| 500-type cars | 50 | 93 | 52 | 93 |
| 600-type cars | 50 | 93 | 52 | 95 |

## St. Louis.

The Public Service Commission of Missouri, on May 4, 1915, issued an order prescribing service to be rendered by the United Railways Co. of St. Louis on its street railway line within the city of St. Louis. This was the first order providing a standard ratio of seats to passengers dependent upon the headway on each line. Portions of the order relating to car service follow:

*Ordered:* 1. That the United Railways Company, defendant herein, be and it is hereby directed and required to operate its system of street railway lines in the city of St. Louis, Missouri, in compliance with the standards of service and other regulations specified in this order, and to provide sufficient power, cars and other equipment, and a sufficient number of supervisors, collectors and other employes to comply with all the provisions of this order:

(*a*) That sufficient cars shall be operated from 5:30 a. m. to 12 midnight so that there shall be supplied during any half-hourly period the average number of seats for each 100 passengers demanding transportation in a given direction at any point on the line specified in the following table, except where the application of this standard would result in a headway in excess of six minutes within the district bounded by the Mississippi river, Arsenal Street, Grand Avenue and its prolongation to the river; and a headway in excess of seven minutes in that portion of the city not included in the above district; *Provided, however,* that this provision relative to headway shall not apply to the Chouteau, Spalding, Marcus

and Tiffany lines; *Provided, further,* that it is considered that a fifteen-minute headway provides adequate service on said last named lines, except during the rush periods on said Chouteau line.

SEATS PER 100 PASSENGERS

| HEADWAY IN MINUTES | Non-rush period | Transition period | Rush period |
|---|---|---|---|
| 1 and less | 121 | 100 | 71 |
| 2 | 124 | 100 | 72 |
| 3 | 127 | 100 | 73 |
| 4 | 130 | 102 | 74 |
| 5 | 133 | 104 | 75 |
| 6 and over | 136 | 106 | 76 |

**Headway in Minutes:**

(*b*) The term "Headway in Minutes" to be used as an index in the above table, is defined as the time spacing between cars on a line, expressed in minutes.

**Line:**

(*c*) The term "Line," when used in this order, means a certain designated route, such as "Olive," "Page," "Park," "Compton," or "Broadway," etc.

**Rush Period Defined:**

(*d*) For the application of the standards of service, the rush periods shall be designated as follows:

For week days, including Saturday, the morning rush period shall be considered to exist from 6:30 to 8:30 a. m.

For week days, Monday to Friday, inclusive, no mid-day rush period shall be recognized, but on Saturday the mid-day rush period shall be considered to exist from 12 noon to 2:00 p. m.

For week days including Saturdays, the evening rush period shall be considered to exist from 5:00 to 7:00 p. m.

**Transition Period Defined:**

(*e*) For application of the standards of service, the transition periods shall be designated as follows:

For week days, including Saturday, the transition periods shall be considered to exist from 6:00 a. m. to 6:30 a. m., from 8:30 a. m. to 9:00 a. m., from 11:30 a. m. to 12 noon., from 2:00 p. m. to 2:30 p. m., from 4:30 p. m. to 5:00 p. m., and from 7:00 p. m. to 7:30 p. m.

**Non-Rush Period Defined:**

(*f*) Sundays and other periods, not included in the above specified rush and transition periods shall be considered non-rush periods, except holidays and special occasions.

**Demand for Service:**

(*g*) The standard of loading for each of the specified periods shall be applied by half-hourly periods, consisting of any two consecutive fifteen-minute periods, beginning on the hour or any fifteen minutes thereafter. The demand for service shall be determined separately for

week days, Monday to Friday, inclusive, Saturdays and Sundays. The average count of passengers for two consecutive week days, excluding Saturday, shall be considered as the demand for service on week days, exclusive of Saturdays. The average count of passengers for two consecutive Saturdays shall be considered as the demand for service on Saturdays. The average count of passengers for two consecutive Sundays shall be considered as the demand for service on Sundays.

These averages shall be drawn from the actual count of passengers for corresponding fifteen-minute periods during each of the specified rush, non-rush and transition periods.

The demand for service shall be determined by actual count of passengers, twice a year by the United Railways Company on all of its city lines. The Commission will notify the company when these checks are to be made.

(*h*) For holidays and special occasions, at such times as the traffic is distinctly greater than the normal, defendant company shall use all reasonable efforts to supply such service as will meet the standards of service herein specified for rush periods.

(*i*) During rush hours traffic supervisors with authority over trainmen shall be stationed at important transfer intersections and such other points as will materially assist in the movement of traffic and the maintenance of schedules, and it is hereby made the duty of such supervisors, as far as practicable, to limit the loads on individual cars to the maximum comfortable carrying capacity of the various cars used.

## Chicago

The service of the Chicago Surface Lines was under the regulation of various local boards and committees prior to the establishment of a state public utilities commission. Not long after this board was appointed, complaints were filed concerning various aspects of the service in Chicago and there has recently been issued by the Public Utilities Commission, a comprehensive opinion and order from which the following quoted paragraphs are of particular interest:

FROM THE OPINION:

* * * The companies urged that some provision should be made during the rush-hour period, to keep the tracks reasonably clear of vehicles.

It is the opinion of the Commission that this contention is well founded, and that the City of Chicago and the respondents should coöperate and provide a reasonably clear right-of-way for the cars in the congested districts during the rush-hours. The Commission believes that some provision should be made to prevent the parking of automobiles and other vehicles during the rush-hour period in the streets in which there is not sufficient width between the curb line and the car tracks for vehicles to pass where automobiles and other vehicles are parked. * * *

Regarding the whole matter of congestion in the "Loop District" the Commission in determining a fair service standard will consider that track capacity in that district taken in connection with the main arteries entering the loop is not reached until the headway is as low as twenty seconds; that the operation by respondents of trailers is practicable and will afford relief and that it is feasible to reroute a great many of respondents' lines and that such rerouting will increase the track capacity in portions of the tracks where safe capacity has already been reached.

The Commission is of the opinion that there is need of additional turn-back service in the zone immediately adjacent to the "Loop District." * * *

* * * The Commission realizes that the demands for the service will vary with the changes which are constantly taking place in this industrial district. The traffic department of the respondents should meet this situation by making sufficient service checks at appropriate intervals to enable them to provide adequate turn-back service and additional loops needed both in the outside edge of what is known as the congested loop district and in the outer zone as well.

From all of the evidence, it is the opinion of the Commission that a scientific rerouting of the cars in and through the loop district would greatly increase the track capacity of the respondents and thereby greatly improve the service. However, the Commission is not disposed to fix schedules or to lay out new routing plans. It is our belief that the matter of routing cars is primarily the function of the traffic department of the street railway company, and the Commission is disposed to allow the operating details involved in rerouting to rest with the Company. * * *

* * * They also set forth that at various places throughout the city it would be of great benefit if certain streets now closed, largely because of railroad and other industrial properties, were open to traffic. These contentions, as well as those relating to the need of a reasonably clear right-of-way during the rush hours, are well founded. It is to the interest of the patrons of the street railway lines that the city authorities take active steps to remedy these situations. * * *

The question as to what constitutes adequate street railway service has had a varied interpretation depending upon all of the traffic characteristics of each locality. It is evident that service which might be considered adequate in one city under a certain set of conditions might be entirely inadequate in another city where the conditions were entirely different. In general, adequate service may be considered as that service which furnishes a sufficient number of cars to carry safely and as comfortably as possible all the passengers who desire to ride over the shortest routes practicable and with the greatest speed consistent with safety. All of these factors will depend more or less upon what might be termed the traffic characteristics of the locality.

FROM THE ORDER:

It is hereby determined and ordered that the Chicago Surface Lines, the Chicago City Railway Company and the Chicago Railways Company, upon all of their tracks and the tracks operated by any of them, where cars are operated from point to point, shall operate these cars between the hours of six o'clock a. m. and twelve o'clock midnight (except during the morning and evening rush-hours of all week days, hereinafter provided for) at such intervals that the cars passing any point on their routes in each direction during any fifteen-minute period between said hours, shall have an aggregate seating capacity of not less than the aggregate number of passengers carried on said cars passing said point in each direction during said fifteen-minute period.

Provided, however, that if less than three cars of any line or lines pass any point at which a check is made during the said fifteen-minute period, then the aggregate number of seats carried by three consecutive cars in any one direction on any line or lines shall not be less than the aggregate number of passengers carried by the said cars in the same direction.

It is further ordered that at no time or place on any line or route operating in the City of Chicago shall there be scheduled less than

one car during each and every twenty-minute period of the entire twenty-four hours of each day, with the six hours between 12 o'clock midnight and 6:00 a. m., excepted.

It is further ordered that the respondents, on all week days, during the hours hereinafter defined as the morning and evening rush-hours, shall on all of their lines where cars are operated from point to point, operate these cars at such intervals:

A — That the cars passing any point on said routes, or lines in each direction during the maximum or middle period of one and one-half hour of the greatest passenger travel of the said two and one-half hour rush-hour period, shall contain during any and every half hour of said one and one-half hour of said rush-hour period, an average of eighty-five car seats for every one hundred passengers carried by said point in each direction upon said route or line during said one-half hour.

B — That the cars passing any point on said routes or lines *in each direction* during each of the two thirty-minute intervals, or transition periods, one immediately preceding and the other immediately following said maximum one-hour and thirty-minute rush interval referred to in paragraph A of this section, shall contain an average number of car seats amounting to ninety seats for every one hundred passengers carried by said point in each direction upon said route or line during each of said periods.

Rush hour periods for the purpose of determining compliance with the service standard provision of this order are defined to be the morning and evening periods between the hours of 6:30 a. m. and 9:00 o'clock a. m. and 4:15 o'clock p. m. and 6:45 o'clock p. m., Sundays and holidays excepted.

The standard of loading for each of the specified periods shall be applied to any half-hour period for rush-hour periods, consisting of any two consecutive fifteen-minute periods of said rush-hour period, and the standard for non-rush-hour periods shall be fifteen-minute periods. The demand for service as shown by checks shall be determined separately for week days (Monday to Saturday, inclusive) and separately for Sundays. The average count of passengers for three consecutive normal week days, shall be considered as the demand for service on week days. The average count of passengers for two consecutive Sundays shall be considered as the demand for service on Sundays.

Tracks shall be deemed to be operated to their full capacity at any checking point when the combined headway of cars and trains, passing such checking point in the same direction is twenty seconds or less, excepting on lines operated through tunnels where an average headway of thirty seconds or less shall be deemed to be the full capacity of such tracks.

In the foregoing orders there will be observed considerable variety in the methods by which it was proposed to secure adequate service. The early service orders were so rigid as to preclude efficient operation both from the standpoint of the management and the patron. Later attempts to reach sufficient flexibility were in a measure experimental, there being a lack of sufficiently accurate knowledge of the characteristics of the flow of traffic to permit a close adaptation of service to traffic demands. As is pointed out in previous chapters the determination of the necessary information upon which to prescribe service requires much careful thought and labor.

A reading of the decisions in order of their dates of promulgation discloses a generally increasing tendency on the part of regulating bodies to adjust the frequency of service to traffic characteristics. The decisions also disclose an appreciation of the fact that adequate service is dependent upon the financial ability of the company to render such service.

In addition to the standards previously cited, a number of recommendations have been made by boards not having mandatory powers and by consulting traffic experts. The more important of these have been summarized under headings referring to the locality to which they apply. It is obvious that these suggestions were made in reference to local conditions in each case and were not intended to be of general application. It should also be noted that some of the suggestions are not practicable and if adopted by regulatory bodies, would prove confiscatory. They are cited here merely as indicating the variety of the methods used in attacking the problem of adequate service.

The Board of Supervising Engineers, Chicago Traction, in its Sixth Annual Report, included the following paragraphs:

As a result of the failure of the city to establish the validity of the present Code provisions in the overcrowding cases, attention has been drawn to the question of a satisfactory service clause that would stand judicial test for reasonableness. In this connection, the following memorandum is presented defining some of the technical points involved in such a satisfactory service standard.

A service standard adequate for all periods of the day is so complex in its nature (due to the enormous variation in travel and the necessary change in operating conditions), that such a standard cannot be defined by means of a single blanket clause, unless very broad discretion coupled with power of enforcement are vested in that particular body entrusted with the duties of carrying out an ordinance involving such a service standard. The items hereinafter mentioned may be regarded as individually and collectively essential to the establishment of proper service, and ought to be recognized in any ordinance that may be expected to stand the test of reasonableness in the courts:

*First.* Maximum powers of public supervision require minimum specification of detail and *vice versa.* With maximum discretion, a short ordinance may be made much more strict as regards the major part of the service. With no discretion, a short ordinance must be sufficiently liberal to cover all conditions and hence may be of doubtful utility.

*Second.* Direct power of enforcement is essential in either case coupled with a reasonable penalty and appeal only through the courts.

*Third.* In any event, certain matters such as count points, duration of rush hour, transition and count periods must be specifically covered in the ordinance or the power to fix them delegated to the supervisory authority.

*Fourth.* This standard for the *maximum rush period* should be more or less flexible [1] and should be based upon the essential unity of the entire service. It must take into consideration the effect of the limited track capacity in the down-town and other districts on the lines or

[1] Any rush period standard should be determined by a fixed amount of floor space per standing passenger, so that in addition to a seated load, the available floor space on each type of car would control the average maximum load.

routes entering those districts, and must also take into consideration the fact that the wave of travel moves from the outlying territory to the down-town district in the morning and reverses this direction in the evening, and that the maximum rush period follows the crest of this wave of travel.

*Fifth.* Service standards[1] for *transition periods* (occurring before and after maximum rush period). These transition periods are necessary in order to secure a uniform gradation in standard from maximum rush down to normal non-rush conditions, as near as is practicable, thus approximating the actual fluctuations in travel. Obviously, a better standard is possible during transition than during maximum rush periods, *i. e.*, standards between the maximum rush and the normal day standards. Each transition period itself may be graded according to the duration of the total rush period assigned.

*Sixth.* Service standard for normal *non-rush hours* (exclusive of owl service) covering the entire operating day up to the transition periods. It is here possible to provide in the aggregate practically as many seats as passengers carried, depending upon the interval of count.

*Seventh.* Service standard for night or owl cars. Owing to the peculiar conditions in various parts of the city, owl service requires more or less definite specification by routes.

*Eighth.* Period of service count, or interval, to be applied in determining a fair average loading for a number of consecutive cars passing a given point should be adjusted roughly in proportion to the car movement but not exceeding a certain maximum, *e. g.*, 15 to 30 min. required for the reasonable convenience of patrons.

*Ninth.* Minimum service (or headway) needs to be specified in order that certain practical limits may not be exceeded in length of headway on light lines even though otherwise operating within the specified service standards as regards car loading, *e. g.*, for a fixed period, certain special cases excepted.

*Tenth.* Maximum comfortable car loading incorporated in the various service standards, being variable according to the type of car operated, should be based upon the seating capacity of the car, plus a definite standing capacity computed from the net available floor or standing space (exclusive of knee room, and exit and entrance gangways), at a fixed number of square feet per standing passenger, according to the period during which such standards are applied.

*Eleventh.* Preferential standing should be allowed for in specifying service during the period when seats provided must be equal to the aggregate number of passengers carried. Observations have shown that just before the seats are entirely filled there may be as high as 20 per cent of the passengers standing by preference, especially where smoking is permitted on the front platform.

*Twelfth.* The imposition of penalty for infraction of the service standard must be made flexible enough so that exemptions at the discretion of the supervisory body will be possible; otherwise bridge openings and obstructions due to accidents, teaming, building material and store-front deliveries may quite reasonably be cited by the companies as grounds for such exemption in any court proceedings.

---

[1] See footnote preceding page.

Previously an ordinance designed to compel the surface lines of Chicago to provide a seat for every passenger until a headway of 45 sec. was reached, was recommended for passage by the Service Betterment Subcommittee of the Local Transportation Committee, but not adopted. The penalty fixed for its violation was $200. The city's representative on the Board of Supervising Engineers argued against the measure on the ground that it was too flexible and would not work out in practice.

This was followed by the introduction of an ordinance to establish a standard of street railway service by the operation of cars in accordance with schedules to be filed with the Commissioner of Public Service, which should provide a headway from 6 a. m. to midnight such that at any point during any 30 minutes the seating capacity should not be less than the aggregate number of passengers carried on the cars past such point.

PHILADELPHIA.

The 1911 report of Messrs. Ford, Bacon and Davis to Pennsylvania State Railroad Commission in the matter of service on the lines of the Philadelphia Rapid Transit Co. contains a statement substantially as follows:

*Standing Room.* The standing room of a surface car is considered as the available aisle and platform space. From experience and test of various types of cars it has been found that an available standing space of 4 sq. ft. per standing passenger provides sufficient room for comfort and for free movement through the car. This for a longitudinal-seat car means practically two rows of standing passengers in the car, providing aisle space for passenger movement between.

* * * While the standing capacity is based on 4 sq. ft. per standing passenger, the total seated and standing capacity of the interior of the car will equal about 3.5 sq. ft. per total seated and standing passenger, which is about the same proportion as exemplified by recent American practice and certain governmental regulation abroad (pages 29–30).

In confidential report made by Ford, Bacon and Davis to the Receivers of the Metropolitan Street Railway Co. of New York City, dated January 4, 1909, on the New York City standard car, 4.3 sq. ft. per standing passenger is used to estimate the standing capacity. All the above data refers to surface cars.

In the Ford, Bacon and Davis report to the Pennsylvania State Railroad Commission the figure of 4 sq. ft. per standing passenger is used in estimating the standing capacity of subway and elevated cars.

In the report of the Transit Commissioner, City of Philadelphia 1913, the service necessary to be provided on the proposed rapid transit lines was calculated by estimating the passengers to be carried and then applying the following rule:

The number of cars required to carry this number of passengers passing the maximum load point during the maximum hour was then determined on the basis of a maximum load of 107 passengers or an

average of 86 passengers per car. The maximum rush hour load limit of 107 allows 4 sq. ft. of standing room per passenger, and the average load of 86 passengers is based on the ratio of 80 per cent found to exist between average and maximum rush hour loads (page 89).

The schedules have been prepared with proper regard to suitable headways during the non-rush hours, and to providing seats for all passengers during such hours (page 90).

## Pittsburgh.

In the report of Bion J. Arnold on the Pittsburgh Transportation Problem, the following comment is made:

*Adequate Service.* Above all else the whole transportation arrangement should be devised to provide adequate service. * * *

Just what constitutes adequate service is not easy to define. The actual service supplied is necessarily affected by the amount of investment, the rate of return on the investment and the cost of operation including renewals.

If all these factors are accurately known, then adequate service might be defined in terms of income or fare, that is, a given fare would mean a corresponding service,— raise this rate of fare and the service could be improved. But to reach a conclusion as to adequate service by this method means:

1. An official appraisal as to the value of the property, both of its "costs to reproduce" and the depreciated or "present value;"
2. An official decision as to the rate of return to be allowed on this value as well as upon all new capital required for rehabilitating the property and for extensions and for betterments;
3. Some system of public record which will make it possible for an authorized check to be made upon the cost of the property, the service supplied, and the cost of operation from time to time (pages 5–6).

While it is generally recognized in this country that a seat for every passenger is impracticable during rush hours, knowledge of the fact that such practice is possible in foreign cities seems to justify the more insistent demands for more seats here at the time passengers wish to travel (page 20).

Other ordinances limit the number of standing passengers which may be carried in any one car, require the company to operate a sufficient number of cars, so that patrons shall not have to wait more than 15 min. for a seat * * * (page 58).

## St. Louis.

The former Public Service Commission of St. Louis, acting in an advisory capacity, had suggested an ordinance to impose standards of service by ordering that a given number of trips be made in various districts within a limited area of the congested district, the utility being required to operate its cars so that at least 7 422 car trips should be made into said districts every 24 hours. This number of trips was reduced somewhat for Sundays and holidays.

Cars operated on lines which do not enter the congested district were to be operated so that the sum of the number of cars passing in both directions the intersection of certain specified streets should be within each 24 hours not less than 3 896 cars; substantially the same number of car trips being prescribed for Sundays and holidays.

### San Francisco.

In the report of Bion J. Arnold on Transportation Facilities in the City of San Francisco, 1913, the suggested standards are as follows:

#### CAR CAPACITIES

In the development of a "service standard" an element of pure judgment arises in what may be considered as car capacities — that is, seated load plus standing load. Various methods have been applied heretofore to obtain a measure of "comfortable" standing capacity.

*First:* Standing floor area has been computed at a fixed number of square feet per passenger, considering standing passengers as distributed indiscriminately throughout the car without reference to the maintenance of a proper aisle space.

*Second:* An arbitrary number of standing passengers is allowed opposite each seat.

I am inclined to favor the second plan, as it is definite and more applicable to the particular type of car under consideration. This rule applied to wide Sutter Street cars on the one hand and the standard Geary Street cars on the other, results in a relative "comfortable" capacity of 98 and 81 respectively, both with 44 seats in the car body.

While the above rule may be regarded as a "comfortable capacity" for the modern double truck San Francisco car, excessive loading under unusual traffic conditions such as baseball games warrants a higher loading. On a basis of 3 sq. ft. per standing passenger, the wide longitudinal seat car will accommodate 108 passengers, and with 2 sq. ft. per standing passenger, 134 passengers per car.

It is therefore recommended that reasonable standards to be applied to all types of cars are as follows:

(1) Comfortable standing, 50 per cent in excess of cross seats, and 100 per cent in excess of longitudinal seats, plus platforms.

(2) Normal maximum capacity, three square feet per standing passenger.

(3) Emergency maximum capacity, two square feet per standing passenger.

### Kansas City.

In the report of Bion J. Arnold on the Metropolitan Street Railway System, Kansas City, Mo. (page 165), the suggested standards of service are thus described:

#### CAR CAPACITIES

Specific recommendations with regard to the number of cars required on the various lines in order to handle the present traffic are shown ...... in a table. This table indicates such average quantities for the cars operating on the various lines as the square feet of standing space and the standing capacity on the basis of three square feet per passenger, which when added to the average seats gives what is assumed to be the total comfortable rush hour carrying capacity of the cars now operated on the route in question. From this data the percentages of seated and standing load were determined for this comfortable rush hour loading, and comparisons were then made between the percentage seated and standing, in accordance with this assumption, in the column showing comfortable loading, and the comparative percentage seated and standing, as actually found for the 30 min. peak and the 15 min. peak. The last column shows the additional cars that would be required in order to provide comfortable rush hour

loading for all passengers for the 15 min. peak, which when once provided for, automatically takes care of the 30 min. and the 90 min. peaks — in other words, the number of cars as determined by this table is a maximum recommendation, and if placed in service will reduce the percentages now appearing in the column showing the loading for the 15 min. peak to an equality for those shown in the column for comfortable rush hour loading.

PROVIDENCE.

In Mr. Arnold's report on the Providence Traffic Situation it is suggested that:

Satisfactory service for non-rush hours should be such that during a given period, for example, 20 min., there should pass by a given point of maximum loading as many seats as there are passengers to be carried during that period (page 66).

In a city like Providence, where the maximum evening peak is sharply defined, capacity should be estimated as that necessary to handle this peak (page 76).

We may then accept 133 per cent average hourly loading as a not unreasonable basis of service, as it can be furnished without hardship in the city of Providence.

The seating capacity adequate for normal hours is then a matter of judgment. In cities where the rush traffic is not so sudden as in Providence, the ratio between normal and rush hour service need not be as great, but in Providence the ratio of 1 to 2 is practically a necessity (pages 76–77).

CINCINNATI.

A report by Ross W. Harris to the City of Cincinnati on Traffic Conditions, 1912, comments upon service standards in that City as follows:

A comfortable load is possible only when every passenger is comfortably situated in the car; that is to say, when he has an opportunity of occupying a location in the car in accordance with his personal preferences. In other words, a comfortable load is such that every person under average normal conditions who desires a seat may have one; while those who desire to stand of their own initiative may stand comfortably. A comfortable load is equal to the seating capacity plus the number of people who will stand by preference (page 15).

The standard used as a basis for determining the amount of service required in this investigation is a "comfortable load," and in this report is an average standard load for a period of 15 min. It is equal to the seating capacity plus the number of passengers who will stand by preference. Standing by preference is a function of the type of car and the characteristics of the traveling public .... The average load during the 15 min. period should not exceed the comfortable load for the type of cars operated on each particular line, and any one load occurring in this 15 min. period should not exceed the standing maximum capacity of the car (page 26).

The number of preferential standers for any car load is peculiar to the conditions existing in each locality:...... In Madison, Wis., 21 per cent of any load will stand by preference; in La Crosse, 15.5 per cent; in Lincoln, Neb., 14.0 per cent; in Milwaukee, 19.0 per cent, while in Cincinnati...... 15.5 per cent...... (page 15).

* * * The degree of loading often fluctuates from causes beyond the control of the operator of a system. For this reason there may

be cases when the people prefer to occupy space on a car under most adverse conditions. In cases of this kind the maximum load should not generally exceed the seating capacity of the car plus the number of people who can conveniently and comfortably stand.

As a result of special studies in various cities, the space into which passengers will crowd themselves under conditions of this kind has been determined. In Minneapolis a large number of observations indicates that standing passengers will arrange themselves into an average of 2.5 sq. ft. per passenger in rear vestibules, 6.4 sq. ft. in the rear aisle and 12.9 sq. ft. in the front aisle, the test indicating that one person will stand comfortably when forced to do so in 4.3 sq. ft. A similar result was obtained by a study of Milwaukee, Wis., and Lincoln, Neb., conditions (page 16).

## Winnipeg.

Recommended service for Winnipeg, Manitoba, Canada, contained in the report of Mr. Robert M. Feustel, is as follows:[1]

*Adequacy of Service:* Adequacy of service, as considered in this report, is taken to mean the condition of furnishing a sufficient number of cars to carry all the passengers who desire to ride, with the greatest degree of safety to the passenger in the car and to the people on the street, with the maximum amount of speed consistent with such safety, with the maximum degree of regularity and certainty of schedule, with the maximum comfort of the passengers, going over the shortest reasonable routes, and with an adequate return to the company for such service furnished.

*Determination of Seat Ratio:* * * * simple standard by which a measure of adequacy of service furnished might readily be made at any future time. The basis for this measure was considered to be the number of passengers riding for any 15-minute period, and the service was measured in the ratio of the number of seats furnished to the number of passengers riding.

The totals for all the passengers riding for half hour periods for all lines for the entire day were made, and the ratio of the maximum load to the average load was computed. This ratio was found to be approximately 140 per cent.

*Standards of Service:* * * * during the non-rush hour, except for accidental loads, seats should be furnished for all passengers who desire to ride. In order to furnish seats for all these passengers from the ratio of the maximum to the average as computed for the lines, it will be found necessary to furnish 40 per cent more seats than passengers riding during the non-rush hour. The service during the rush hour was based on maximum car capacity. The average seating capacity of the Winnipeg car was determined, and to this seating capacity an allowable standing capacity of four square feet per passenger was added. This gave the maximum load for the largest car of 85 passengers and an average load of 79 passengers for all cars. It was considered reasonable to establish 85 as the extreme maximum load which should be allowed for schedule making. In the determination of the ratio of the maximum load to the average load for the rush hour period, 145 per cent was found to be the average for all the lines, with a maximum allowable car load of 85 passengers, the average car load would necessarily be 85 divided by 1.45, or 59 passengers. The seating capacity of these cars being 42, the number of seats necessary to keep the average load to 59 passengers would be the

[1] Robert M. Feustel — Report on the Winnipeg Street Railway Service to the Public Utilities Commission of Manitoba, 1914, pages 2 and 3.

ratio of 42 to 59, or approximately 71 per cent. In order, therefore, to limit the maximum load to 85 passengers during the rush hour period, it will be necessary to furnish 70 per cent as many seats as there are passengers riding. In order to make a check as to the adequacy of service, a count should be made for at least three normal days of the total number of passengers riding by the point of maximum loading, and if 140 per cent as many seats are furnished as there are passengers riding for the non-rush hour, and 70 per cent as many seats are furnished as passengers are riding for the rush hour, service will be considered as adequate. The change from the 70 per cent to the 140 per cent ratio must necessarily be made in as gradual a manner as will be suitable to the particular line in question.

It has not generally been recognized that there is considerable danger in attempting to adopt service standards as promulgated in one city for purposes of regulating the service of companies operating under essentially different conditions. In the foregoing studies, it appears that there are certain factors which must be considered independently in each service case in order that substantial justice may be given to the patrons and company alike. These considerations may be discussed under suitable headings as follows:

### DIVERSITY.

One of the first difficulties met by those attempting to prescribe service standards arose from the fact that the flow of traffic into cars is not uniform. This lack of uniformity is customarily measured by dividing the maximum load by the average load for a given period, usually thirty minutes or an hour. This ratio is termed the diversity factor, or diversity. Eliminating unusual conditions, the diversity will frequently be found, from tests extending over several days and covering a number of lines, to average 1.5 and occasionally 2.0. Thus, for example, if 30 cars with a seating capacity of 40 passengers each, leave a certain point in an hour and carry 1 200 passengers it will be found that a considerable number of passengers are standing and that there are an equal number of vacant seats. To supply seats for all passengers would therefore require the operation of cars, the capacity of which was far in excess of the actual number of passengers. It was early recognized that it was physically and financially impossible for a company to meet these instantaneous demands. A compromise was then effected whereby the service during a limited period, say 30 minutes, was required to be sufficient to meet the total demand during that period.

Whether this factor, fluctuation or diversity in car loading, can be reduced to such definite terms as to permit its use in calculating service standards is not yet clear, but it is an important element.

### CAR CAPACITIES.

Since the car is the unit of equipment and not the seat, the meeting of traffic demands by the schedule maker is based upon a classification

of cars as to capacity. It is customary to determine from the plans of each type of car the seating capacity and the capacity including standing passengers, and to base schedules, where determined by traffic, on these capacities. Various rules are in use for computing the number of passengers that can be seated on longitudinal or transverse benches, from 15 to 18 inches being allowed per individual. The floor area measured in square feet is customarily divided by two, three or four to determine the number of passengers who can stand comfortably.[1] In bench cars, from eight to ten inches is added to the width of the seat to allow for knee room and similarly the floor area devoted to any obstruction, such as fare boxes, stoves or control apparatus is deducted before estimating the comfortable standing load. Some consideration has frequently been given to methods of fare collection and rules as to entrance and exit as affecting the distribution of passengers throughout the car. The design of certain recent cars suggests the necessity of greater attention in the future to those factors which differentiate cars of the same length as to their carrying capacity, and there appears to be a growing inclination on the part of those prescribing service to take into account the essential details of the equipment with which the service must be rendered.

### VARIATION IN PASSENGER DEMAND.

Passenger demand cannot be definitely predicted. As pointed out above, the number of passengers desiring to ride on any one car may be many times the average number of passengers per car.[2] There are other variations in the flow of traffic which must also be borne in mind in considering the relation of transportation to service. The most obvious and best understood characteristic of service is the variation from hour to hour throughout the day, which gives rise to the rush hour. Seasonal variations with the characteristic summer riding to parks and places of amusement is an important factor in the schedules of many companies. Certain other of the fluctuations which have a relatively long period have been recognized and studied but the problems presented thereby have by no means been reduced to terms capable of exact definition and solution. Although it is likely that additional study will throw more light on these problems, the schedule maker will still find difficulty in segregating the factors responsible for the variation from day to day in the traffic to be handled during any hour. It has been found, for example, that on

[1] Standards adopted by the U. S. Army are based on the experience that an area of 3.35 sq. ft. per person will permit free manoeuvering.

[2] It is the opinion of the Commission that questions of the overcrowding of cars and of the headway upon which they are run should not be determined by the consideration of individual cars, but by examination of the number of cars run in a reasonable period and the number of passengers who ride on those cars during that period. For a service like the one under consideration here a period of twenty minutes has been thought reasonable. If during such period the headway has been reasonably maintained and sufficient cars furnished so that the average car in the period has not been overcrowded, the service can not be held to be inadequate.— Foster et al., v. International Ry. Co.— Public Service Comm , 2d D., N. Y.— 153. Decided October 26, 1911.

the lines of a typical urban system the number of passengers riding cn one day between 2:00 and 3:00 p. m. was 128 per cent of the average number for that period during the five comparable days of that week. This is considerably greater than the usual variation from the average, 10 per cent probably being as great a departure as normal conditions will disclose.

The above factors serve to complicate the problem of adjusting service to traffic and are mentioned not as indicating that careful study is wasted effort, but rather that it is essential to the proper working out of the problem.

### COST OF SERVICE.

The cost of complying with service standards is discussed at some length in Chapter XVI. With private capital engaged in public service, the final test of the adequacy of service must always be the relation existing between the patrons of the railway and its owners. If the patrons are receiving less or more than they are paying for, the service should be adjusted. How it should be changed and to what extent, is a problem which must engage the careful attention of all affected.

### PRACTICAL ASPECTS OF COMPLYING WITH SERVICE STANDARDS.

Much that has been reported in the foregoing paragraphs is pioneer work and has of necessity been based on somewhat academic considerations. It should be pointed out that certain of the prescribed and suggested standards are such that compliance therewith is not only financially impossible but is beyond physical possibility as well and the literal compliance with the service prescribed would add but little to the quality of service.

Standards of service, founded upon the ratio of seats to passengers, and which are predicated upon the theory that the utility can forecast the future with complete accuracy, it is impossible to comply with in every instance. The number of car hours and the expense incident to the operation of service necessary to make certain that no car at any point at any hour of any day will be operated under conditions effecting a smaller ratio of seats to passengers than that prescribed in the standard puts a complete compliance with such standard in the realm of the unattainable. The use of diversity factor of car loading for the purpose of providing enough seats to insure a seat per passenger has obvious merits but it must follow that if the utility constructs its schedule upon the basis of the excess of seats to passengers pre-determined by this method, it should not be penalized if, upon a subsequent traffic count, the seat ratio be found at some point, at some time, to depart from that anticipated at the time the standard was adopted. It is most unlikely that the officers of the utility or other traffic experts can forecast the future with complete accuracy and that failure to do so shall operate to heavily mulct the company through fines appears unreasonable. If utilities are to be required to

give an excess of seats over passengers during non-rush hours, a schedule providing this and based upon a traffic count taken prior to the construction of the schedule should be prima facie evidence of compliance with the standard, provided the schedules are modified at frequent intervals dependent upon the seasonable changes.

A few only of the factors to be considered have been pointed out but they amply prove the contention that great danger exists in "borrowing" standards of service as used in one community for application to another.

### CONCLUSIONS.

The following general conclusions may be drawn:

1. The study of standards of service or what constitutes reasonable service has failed to disclose any general rule which may be applied, other than the fundamental one that the standard of service must be determined in relation to its cost.

2. The subject of standards of adequate service is one which is worthy of considerable added scientific study. There is, however, at the present time no reason to believe that it will be possible to lay down general rules which are of universal application.

3. The standard of service which is reasonable in any community must be determined by a careful analysis of the financial, traffic and operating conditions in that city.

A further consideration, arising out of the psychological aspects of service is discussed in the succeeding chapter.

## CHAPTER XIII

### PSYCHOLOGICAL ASPECTS OF STREET RAILWAY SERVICE

Importance of the Psychological Aspects of Car Service,—— Results of Tests in Cleveland and Milwaukee as to Impressions of Actual and Reasonable Headway, Comfortable Load, Rate of Fare, and Service,—— Definition of Satisfactory Service,—— Satisfaction with Service,—— Impressions of Courtesy of Conductors, Route and Destination Signs, Transfers, Reasonable Walking Distance, Trail and Center-entrance Cars, Service in Other Cities, —— Conclusions.

The applications of psychology to daily life though of recent origin have been numerous and of sufficient practical importance to claim further attention and study. There have appeared books on the psychology of advertising, on the psychology of public speaking, on psychology in the court room, in the employment agency, and on other applications to daily life. The contribution in this field of greatest significance to the business man and particularly to the railroad man is Professor Münsterberg's "Psychology and Industrial Efficiency," dealing among other things with psychological tests of electric railway motormen. As yet there have been few, if any, attempts to apply psychology to the relations of the electric railway to its patrons, particularly as to the much discussed and indefinite subject "standards of car loading."

It has long been a matter of common knowledge that there are no absolute physical standards of comfort. One individual may find limited standing room quite as comfortable as another finds a spacious seat. The same passenger may have radically different ideas in the morning and in the evening as to what constitutes a reasonable length of time which he should wait for a car.

The following paragraphs quoted from a memorandum recently prepared represent the results of a careful analysis of the problem of the psychology of comfort which has been sensed in the past but which has never been subjected to definite study:

A study of numerous individual complaints as to delays and overcrowding indicates that the impressions that service is poor are largely psychological. With very few exceptions individual complaints as to alleged conditions are found upon investigation to be much exaggerated. This condition does not result from a universal tendency to be untruthful, but has its basis in a lack of mental power of accurate perception. Psychologists have on various occasions commented upon these deficiencies in mental processes.

As has been pointed out in the psychological studies undertaken at the Harvard psychological laboratories, experiments upon students indicate the greatest variety of perception with regard to conditions similar to those obtained upon a crowded car. Professor Münsterberg states, "My own students do not know whether a point moves with the slowness of a snail or with the rapidity of an express train; whether a time interval is half a second or a whole minute; whether

there are twenty-five points or two hundred; whether a tone comes from a whistle, a gong or a violin; whether the moon is as small as a pea or large as a man." The laboratory observations taken upon the perception of time elapsed are particularly interesting. Students were asked to give the number of seconds which passed between two loud clicks. These were separated at first by intervals of ten seconds and in the following experiment by an interval of three seconds. In the first set of experiments, the estimate of time elapsed ranged from half a second to 60 seconds, the prevailing impression being 45 seconds as the right time, or four and one-half times the actual time. In the second experiment the observations ranged from one-half a second to 15 seconds.

It has long been a matter of comment also that the average street railway patron is unable to determine the number of people in a car. Observations as to the number of passengers standing upon a rear platform are frequently estimated from 20 to 150. Similar studies of number perception were made in the Harvard laboratories. Students were shown a large piece of white cardboard upon which 50 little black squares were pasted in irregular order. These were actually exposed for five seconds while the answers varied from 25 to 200, the answers over 100 being more frequent than those below the actual number, 50. When a cardboard was exhibited which contained 20 spots, the replies ranged from 10 to 70.

It is probable that laboratory tests such as those understate rather than exaggerate conditions obtaining in actual operation for the following reasons:

(*a*) The *impatience* of prospective passengers to board the first car leaving for their destination undoubtedly heightens the idea of number and speed. The studies cited by Prof. Münsterberg do not account for the impatience factor in testing out the results he has obtained.

(*b*) The *time duration* of crowding is another important factor which would tend to increase the idea that service is unsatisfactory. From the standpoint of possible physical discomfort a crowded condition obtaining for one-half hour is more serious than the same crowded condition obtaining for one minute. The same is true with psychological discomfort. Prolonged tension with irregularity of speed and stops undoubtedly fixes attention and heightens the susceptibility to petty annoyance.

(*c*) The *appearance* of crowding, which may not in fact exist, tends to an exaggeration of the patron's perception of number. Standing passengers may become grouped in one end of the car instead of being uniformly distributed over the available standing space and this, or the loading and unloading of cars at one end only, may give the appearance of crowding.

(*d*) The condition of mental and physical *fatigue* obtaining during evening rush hours intensifies any dissatisfaction with existing service. This undoubtedly explains the fact that complaints of service during the evening rush period are more numerous than complaints of morning rush service. Temperature, ventilation, frequency of stops, speed, traffic delays, curves, width of aisles, angle at which floor is pitched, location of grab handles, etc., all serve to accentuate the fatigue factor with its attendant irritability and susceptibility to suggestion.

(*e*) The *monotony* of the ride undoubtedly has a substantial effect upon the idea that crowding exists. Studies of the psychology of advertising give a high value to street railway advertising for just this reason.

(*f*) *Inclement weather,* such as cold rain or intense heat or some similar cause leads to an exaggerated idea of the interval between cars and creates a feeling of annoyance before the car is boarded which naturally magnifies actual conditions of loading.

(*g*) The *effect of contrast* of cars only partly loaded during non-rush hours with those operating at higher load factor during rush hours, intensifies the reaction to crowded conditions.

The idea that the car is badly crowded is not merely a matter of error in sense perception. Suggestions and allusions all assist in confirming what has hitherto been a vague impression. The intensity of the idea is increased as soon as the individual is aware that many others have similar feelings. In the ordinary street car during rush hours, with a comfortable standing load, every condition is present which produces the mental interactions referred to by psychologists in their studies of the crowd or group. The monotony of the ride, the touching of elbows, the rhythmic swaying of the bodies of all passengers as the car accelerates, coasts, covers curves and stops, the physical conditions brought about by evening fatigue, lack of proper ventilation, etc., all produce such a condition of heightened suggestibility. The group is "in phase" and intensifies every impression that service is not up to standard. Even the invitation "step forward please" grates upon abused sensibilities and much dissatisfaction is undoubtedly accounted for in this manner. The problem is one of mental anguish rather than physical discomfort.

The determination of adequacy of service must take into consideration these psychological aspects. A car which under the best conditions of comfort moves rapidly to its destination without stops or changes in speed, will cause less psychological discomfort than another car with the same loading during the same period of time but whose journey is prolonged by frequent stops and low speed. By the same standards higher load factors can be utilized for short haul than for long haul traffic. Courtesy upon the part of the Company's employes and a better distribution of standing load through the utilization of both ends of the car will assist in providing service which is satisfactory as well as adequate. The problem of exaggeration of individual complaints and conditions of impatience and mental fatigue, which accompany the evening rush, are factors beyond the control of the utility which will create dissatisfaction with any standard of loading however adequate its design.

The evaluation of any of the factors above enumerated presents many practical difficulties, and opportunities for the collection of data are not frequent. Such results as can be obtained therefore are well worth the effort, and while any considerable advance in the art of making investigations as to the psychological factors entering into a consideration of the standards of service will wait upon the interesting of trained experimental psychologists, the importance of the field is such that it has appeared advisable to make a beginning.

In connection with recent examinations of the service in Cleveland and Milwaukee, opportunity was offered to measure systematically, the opinions of a considerable number of individuals in these cities as to certain facts and impressions not reduceable to anything more tangible than opinion. The method and the results of this investigation are here outlined because it is believed that the methods employed in making the study will be of general interest, and further,

because the results obtained confirm the general impression of those who have given the matter thought, that powers of observation are in general inaccurate, particularly in the perception of time and number, and that individual ideas vary to such an extent that even those living under substantially similar conditions have very different opinions as to what constitutes high class service. The following brief description covers the essential features of the procedure followed in making the tests in both cities.

Before determining the exact questions to be asked, it was necessary to know something concerning the individuals who were to answer them. After some thought, it was decided for several reasons that the most practical scheme was to conduct the investigation among university or high school students. It was not considered desirable to have those answering the questions put any considerable amount of time on them, but rather it was hoped that each individual would state quickly and briefly his judgment or opinion. In order that unstudied answers be obtained, it was necessary to propose the questions to groups of individuals under such conditions that the time of answering could be regulated. An additional important factor considered was that of facility of interpretation and expression on the part of the individual answering the questions. University students are accustomed to interpret written questions and to set forth short answers in as brief and clear a manner as possible, and this fact also made it seem advisable to limit for the present the investigation to this class of patrons. An additional reason for conducting an investigation among these individuals was the fact that in extending the studies to other cities, it will be easier to get in touch with a similar body of individuals than would have been the case had some other type been chosen.

The questions propounded were identical in the two cities, Cleveland and Milwaukee, except where it was necessary to use the names of streets or car lines to illustrate the meaning of questions and except further where the questions propounded in Cleveland referred to a type of equipment not in service in Milwaukee. The questions were not arranged in logical sequence as it was not desired that the students should base answers to later questions on statements previously made. Moreover, the wording of repeated questions was slightly altered and thus became a further check upon the accuracy of the answers. In general the time for answering each question was limited to about 55 sec., or the average time per paper or set of questions was about 20 min. This provided that the answers received were not studied but were rather the result of general impressions. No coöperation in answering the questions was allowed and individual judgment was thus assured. The questions may be divided as to subject matter into the following groups.[1]

1 For a complete list of the questions asked, see Appendix to this Chapter.

1. Questions designed to test accuracy of perception of time.
2. Questions designed to test accuracy of perception of number.
3. Questions designed to test accuracy of judgment.
4. Questions designed to test influence of suggestion or impression upon judgment.
5. Questions designed to bring out opinion as to current street railway practice.

The questions were answered more or less completely and under above described restrictions by over 150 students attending Marquette University at Milwaukee, Wis., and Western Reserve University at Cleveland, Ohio. That the students were sufficiently acquainted with and had taken some interest in the street railway systems and the affairs of their respective cities is shown by Tables XLIII and XLIV. Table XLIII deals with the frequency of street car riding and indicates that 58 per cent of those answering rode customarily on street cars

TABLE XLIII — AVERAGE FREQUENCY OF STREET CAR RIDING

| City | Total | Twice or more daily | Once or less daily |
|---|---|---|---|
| Cleveland | 77 | 44 | 33 |
| Milwaukee | 62 | 37 | 25 |
| Combined | 139 | 81 | 58 |

of Cleveland or Milwaukee twice or oftener daily. In both cases such riding was for a period of at least three years (excluding vacations), since all of those answering were seniors in their respective colleges. It is therefore fair to assume that those answering the questions in both cities had had sufficient opportunity to observe the working of their respective street railway systems and to have formed definite opinions.

TABLE XLIV — DISCUSSION OF THE STREET CAR SERVICE WITH OTHERS

| City | Is question discussed? | | | With whom? | | | |
|---|---|---|---|---|---|---|---|
| | Total | Yes | No | Total | Passengers | Friends | Both |
| Cleveland | 84 | 81 | 3 | 68 | 8 | 38 | 22 |
| Milwaukee | 68 | 62 | 6 | 61 | 15 | 27 | 19 |
| Combined | 152 | 143 | 9 | 129 | 23 | 65 | 41 |

Table XLIV deals with the frequency of discussion of the street car service with others and serves as an indication of interest in local street railway affairs. It shows that a great majority of those answer-

ing (93 per cent) had had some discussion of street railway affairs and that in 50 per cent of the cases, such discussion was with friends and acquaintances, while in 18 per cent of the cases it was with fellow passengers and in 32 per cent with both.

In order to determine whether or not the answers were representative and formed a fair sample, a question requiring a definite numerical reply was selected for test purposes. The Cleveland and Milwaukee answers to this question were tabulated separately and a cumulative frequency curve was constructed from the answers in each city. A combined Cleveland and Milwaukee curve was then added for purposes of comparison, as is shown in Fig. 33. An examination of this

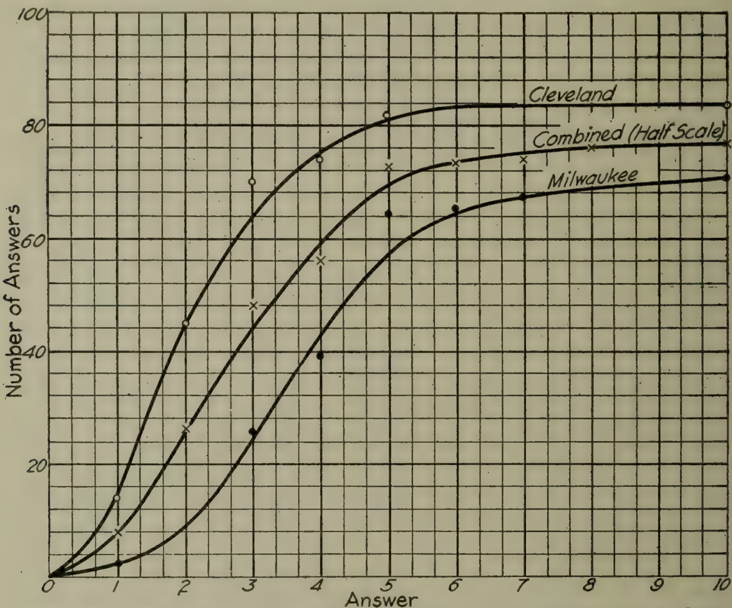



FIG. 33. CUMULATIVE FREQUENCY CURVE OF ANSWERS TO A QUESTION REQUIRING A DEFINITE NUMERICAL ANSWER.

curve indicates that the addition of Cleveland answers to the Milwaukee figures made little if any difference in the character of the cumulative frequency curve. This is ordinarily considered a sufficient test of the representativeness of any set of figures.[1] It is apparent

1 King — Elements of Statistical Method, pages 103, 105.— " Both chance and natural phenomena tend to fluctuate about a norm known as the mode. The large majority of the items are usually grouped near the mode and, as the distance from the mode becomes greater, the items become rapidly fewer in number * * * would an increase in the number of items affect the location of the mode; that is, if 500 had been used instead of 113, would it have changed the results? Experience shows that the only effect of using a larger number of items, provided the smaller number selected were fair samples, is to obtain a greater regularity in the variation in the sizes of the classes."

The mode is ordinarily defined as: " the most frequent size of item; the position of the maximum ordinate in a smoothed frequency curve " or as " the most typical item."

therefore that the present study is fairly representative of intelligent opinion in the cities in question.

After the above tests of the representativeness of the answers had been made, and had proved satisfactory, the following tabulation of replies was made to facilitate analysis.

Table XLV — Estimation of suggested and actual intervals between consecutive cars.

Table XLVI — Influences causing modification of judgment as to the reasonable time interval between cars.

Table XLVII — Estimation of the effect of the time of year and of state of weather upon the actual time interval between consecutive cars.

Table XLVIII — Definition of a comfortable load.

Table XLIX — Factors affecting the maximum number of people that can be carried comfortably in a car seating 50.

Table L — Rate of fare *vs.* service.

Table LI — Definition of satisfactory service.

Table LII — Is the present service satisfactory.

Table LIII — Influence of published complaints on opinion as to the character of street car service.

Table LIV — Courtesy of conductors.

Table LV — Miscellaneous practice.

Table LVI — Reasonable walking distance.

Table LVII — Practice as to type of car.

To further facilitate analysis and discussion, it will be noted that Tables XLV to LIV relate to quality of service, and Tables LV to LVII to opinions as to local street railway practice.

One of the measures of the quality of service is its frequency. The attempt of the average person to judge frequency, results in failure because of the inaccuracy of his perception of time. This has been conclusively established in the laboratory by many experiments[1] However, the following instance taken from Table XLV may here serve as an illustration. The actual interval between cars in the evening rush was thought by some to be as high as 25 min., by others as low as one-quarter of a minute, the average answer being 5.5 min. and the modal, that is, the most frequent or typical answer, being 5 min. An examination of the running schedules of the lines most frequently used by the students showed the average headway during the evening rush to be about 2.5 min., while the maximum was 5.5 min., the minimum was 1.1 min. and the model headway was 3 min. The estimated average headway was thus at least twice the actual headway, while the estimated maximum headway was ten times the actual. Again, the average time interval between cars at various periods of the day was estimated to be less by Cleveland students than by those in Milwaukee, the answers averaging about four and six minutes

[1] Münsterberg — On the Witness Stand, page 22.

TABLE XLV — FREQUENCY OF SERVICE — SUGGESTED AND ESTIMATED ACTUAL INTERVALS BETWEEN CONSECUTIVE CARS

| City | Kind of answer | Suggested interval with various classes of service | | | | | | | | Estimated actual interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Residence district | | | | Downtown district | | | | | | |
| | | Excellent service | Good service | Fair service | Poor service | Excellent service | Good service | Fair service | Poor service | Morning | Midday | Evening |
| Cleveland | Average | 2.6 | 3.8 | 6.0 | 10.3 | 1.4 | 2.5 | 4.0 | 6.5 | 3.5 | 5.2 | 4.1 |
| | Maximum | 10.0 | 12.0 | 20.0 | 30.0 | 5.0 | 8.0 | 12.0 | 20.0 | 9.0 | 12.0 | 10.0 |
| | Minimum | 0.0 | 0.5 | 2.0 | 4.0 | 0.0 | 0.0 | 0.5 | 2.0 | 0.5 | 1.0 | 0.25 |
| | Mode | 2.0 | 3.0 | 5.0 | 10.0 | 1.0 | 2.0 | 3.0 | 5.0 | 5.0 | 3.0 | 2.0 |
| Milwaukee | Average | 4.1 | 6.3 | 9.2 | 13.8 | 2.4 | 4.1 | 6.1 | 9.0 | 5.9 | 6.5 | 7.3 |
| | Maximum | 8.0 | 11.0 | 15.0 | 30.0 | 5.5 | 10.0 | 12.0 | 20.0 | 15.0 | 12.5 | 25.0 |
| | Minimum | 1.0 | 2.0 | 5.0 | 2.0 | 1.0 | 1.0 | 2.0 | 3.0 | 2.0 | 2.0 | 1.0 |
| | Mode | 5.0 | 5.0 | 15.0 | 10.0 | 2.0 | 5.0 | 5.0 | 10.0 | 5.0 | 10.0 | 5.0 |
| Combined | Average | 3.3 | 5.0 | 7.5 | 11.9 | 1.8 | 3.2 | 5.0 | 7.6 | 4.5 | 5.7 | 5.5 |
| | Maximum | 10.0 | 12.0 | 20.0 | 30.0 | 5.5 | 10.0 | 12.0 | 20.0 | 15.0 | 12.5 | 25.0 |
| | Minimum | 0.0 | 0.5 | 2.0 | 2.0 | 0.0 | 0.0 | 0.5 | 2.0 | 0.5 | 1.0 | 0.25 |
| | Mode | 2.0 | 3.0 | 5.0 | 10.0 | 1.0 | 2.0 | 5.0 | 10.0 | 5.0 | 6.5 | 5.0 |

respectively. As a matter of fact, the above answers were greatly in error both actually and relatively.

Even a casual examination of the tabulated replies shows a large number of similar sets of answers all bringing out the same characteristics — inaccuracy of perception of time. It may be of interest to note in this connection that the average interval between cars proposed as reasonable in each city was smaller than the "estimated actual" time interval between cars in that city. The actual figures as taken from the schedules in effect approached more nearly the "reasonable" than the "estimated actual" headway. In other words the students proposed a reasonable headway which was smaller than the headway they judged to be in effect. In reality, what they thought was a reasonable headway was not greatly different from the actual headway and their estimation of the actual time interval between cars was considerably in error.

Not only is the average normal person unable to judge the frequency of service because of inaccuracy of perception, as shown by the great range in the size of answers, but there is always his susceptibility to impression or suggestion to be borne in mind. This suggestion, as defined by Professor Baldwin[1] is "the abrupt entrance from without into consciousness of an idea or image which becomes a part of the stream of thought and tends to produce the muscular and volitional effects which ordinarily follow upon its presence." An example of the working of suggestion is reported in the *Psychological Review* (VI–407) and is described by Professor Ross of the University of Wisconsin as follows:

> A professor of chemistry announced to his auditors: "The bottle which you see before me contains a chemical with a strong and peculiar odor. I wish to see how rapidly the odor will be diffused through the air and will therefore ask each of you to raise the hand as soon as the odor is perceived." With face averted he then poured the liquid over some cotton and started a stop watch. In 15 seconds most of those in the front row had given the sign, and by the end of a minute three fourths of the audience claimed to perceive the smell. Yet the bottle contained nothing but distilled water, and the professor had been measuring the power of suggestion and not the diffusibility of an ordor.[2]

An examination of the tabulated answers of this study confirms this statement. Thus, an examination of Table XLVI shows that only 15 per cent of those answering thought that weather might have any considerable influence on their judgment as to the reasonable time interval between cars when service was excellent while 57 per cent thought it would have none. When the question was asked in such a way as to suggest poor service, 50 per cent instead of 15 per cent thought their judgment would be affected by weather conditions, while 31 per cent instead of 57 per cent thought weather would not be a factor.

[1] Baldwin — Handbook of Psychology II, page 297.
Ross — Social Psychology, page 12

TABLE XLVI — FREQUENCY OF SERVICE — INFLUENCE CAUSING MODIFICATION OF JUDGMENT AS TO THE REASONABLE TIME INTERVAL BETWEEN CARS

| City | Answer | Extent of modification of conclusions as to expected interval between cars in view of duration, destination or purpose of intended ride | | Extent of influence of weather upon judgment as to the reasonable time interval between cars | | | |
|---|---|---|---|---|---|---|---|
| | | | | When service is | | | |
| | | Duration | Destination or purpose | Excellent | Good | Fair | Poor |
| Cleveland....... | Total........ | 69 | 64 | 59 | 58 | 58 | 56 |
| | Great........ | 11 | 4 | 1 | 2 | 7 | 25 |
| | Little........ | 29 | 21 | 15 | 24 | 32 | 13 |
| | Not at all.... | 29 | 39 | 43 | 32 | 19 | 18 |
| Milwaukee...... | Total........ | 64 | 63 | 64 | 64 | 60 | 60 |
| | Great........ | 19 | 13 | 18 | 18 | 20 | 28 |
| | Little........ | 25 | 21 | 19 | 25 | 24 | 13 |
| | Not at all.... | 20 | 29 | 27 | 21 | 16 | 19 |
| Combined....... | Total........ | 133 | 127 | 123 | 122 | 118 | 116 |
| | Great........ | 30 | 17 | 19 | 20 | 27 | 53 |
| | Little........ | 54 | 42 | 34 | 49 | 56 | 26 |
| | Not at all.... | 49 | 68 | 70 | 53 | 35 | 37 |

Moreover, Table XLVII, indicates that nearly 70 per cent of those answering stated that the time interval between consecutive cars was greater in winter than in summer and was greater in stormy than in good weather, while only 12 per cent thought that there was no difference. It is true that in winter there are sometimes unavoidable delays which affect to a minor degree the regularity of schedules but in stormy weather more cars are put on to accommodate those who ordinarily walk and the interval between consecutive cars is therefore smaller than under ordinary conditions. Finally, Table XLVI shows that 63 per cent of those answering thought that the duration of the in-

TABLE XLVII — FREQUENCY OF SERVICE — ESTIMATION OF THE EFFECT OF TIME OF YEAR AND OF WEATHER UPON THE ACTUAL TIME INTERVAL BETWEEN CONSECUTIVE CARS

| City | Time of year | | | | Weather | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Interval greater in winter | Interval greater in summer | No difference | Total | Interval greater in stormy | Interval greater in good | No difference |
| Cleveland.. | 72 | 47 | 17 | 8 | 65 | 49 | 7 | 9 |
| Milwaukee.. | 63 | 51 | 1 | 11 | 62 | 51 | 6 | 5 |
| Combined.. | 135 | 98 | 18 | 19 | 127 | 100 | 13 | 14 |

tended ride would have an influence upon their conclusions as to the reasonable interval between cars, while 46 per cent held similarly concerning the destination or purpose of the ride. It is apparent therefore that the frequency of service is extremely unlikely to be correctly judged by the average patron.

Another measure of the quality of service is "comfort." If it be attempted to measure this by the proportion of standing to seated passengers, a great range of answers will be found. An examination of Table XLVIII shows that the ratio of standing to seated passengers, regarded as good service, is placed at 100 per cent by some; by others at zero per cent or a seat per passenger; while the average answer is about 22 per cent and the modal answer 25 per cent. It is interesting to compare these figures with the results obtained from recent traffic surveys of representative lines in proximity to the university buildings in Milwaukee and Cleveland. These surveys show the average ratio of standing to seated passengers on these lines to be about 22 per cent during rush hours and the maximum ratio on any one line to be about 35 per cent. These figures are for the heaviest hour and for the point of greatest loading. It appears then that the average existing conditions of loading are practically those suggested as reasonable, and that the existing maximum loading on any one line is only one-third of the maximum suggested as reasonable. It should also be noted that the loading figures obtained from surveys indicate that the service in Milwaukee is superior during the non-rush hours and equal at other times to that furnished in Cleveland. Perhaps because of this the Milwaukee estimates of good service demand a much smaller ratio of standing to seated passengers than do similar estimates in Cleveland.

A further examination of Table XLVIII indicates that the proportion of standing to seated passengers regarded as good service and discussed in the first reference to this table, was in the majority of cases (68 per cent), determined by the number of passengers in the car rather than ventilation, difficulty of boarding and leaving and other factors. The great majority thought that more people could be carried comfortably in a car seating 50 during the evening rush than during the middle of the day when the fatigue factor[1] which greatly intensifies discomfort is largely absent.

It is interesting to note in this connection the effect of susceptibility to impression upon the students' opinions as to the maximum number

---

[1] The great influence of the fatigue factor upon standards of car loading is clearly apparent from the following paragraph from Professor Nordau's "Degeneration."

"One can change a normal into an hysterical individual by merely tiring him. Suggestibility from exhaustion or strain is a rather common condition with many of us." (Nordau — "Degeneration," pages 25, 26.)

"Moreover," says Professor Ross, "the strength of multiplied suggestion is at its maximum when the individual is in the midst of a throng, helpless to control his position or movements. The same pressure on the body that prevents voluntary movement conveys promptly to him all the electrifying swayings and tremors that betray the emotions of the mass * * * in the dense throng individuality wilts and droops * * * rational or accurate thinking is arrested." (Ross — "Social Psychology," page 43.)

TABLE XLVIII — WHAT IS A COMFORTABLE LOAD

| City | Kind to answer | Maximum number of people that can be carried comfortably in a car seating fifty (estimated) — During: A. M. rush | Mid-day | P. M. rush | Proportion of standing to seated passengers regarded as good service in per cent. | The proportion of standing to seated passengers determined by — Total | Number of passengers in car | Other impressions: Ventilation | Difficulty in boarding and leaving | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|---|
| Cleveland | Average | 70.74 | 58.60 | 71.22 | 24.35 | 77 | 50 | 11 | 4 | 12 |
| | Maximum | 125 | 100 | 150 | 100 | ........ | ........ | ........ | ........ | ........ |
| | Minimum | 30 | 30 | 30 | 0 | ........ | ........ | ........ | ........ | ........ |
| | Mode | 70 | 50 | 75 | 25 | ........ | ........ | ........ | ........ | ........ |
| Milwaukee | Average | 65.72 | 59.11 | 65.12 | 18.68 | 67 | 48 | 10 | 4 | 5 |
| | Maximum | 100 | 100 | 100 | 90 | ........ | ........ | ........ | ........ | ........ |
| | Minimum | 48 | 30 | 43 | 0 | ........ | ........ | ........ | ........ | ........ |
| | Mode | 50 | 50 | 55 | 25 | ........ | ........ | ........ | ........ | ........ |
| Combined | Average | 68.50 | 58.83 | 68.50 | 21.82 | 144 | 98 | 21 | 8 | 17 |
| | Maximum | 125 | 100 | 150 | 100 | ........ | ........ | ........ | ........ | ........ |
| | Minimum | 30 | 30 | 30 | 0 | ........ | ........ | ........ | ........ | ........ |
| | Mode | 70 | 50 | 75 | 25 | ........ | ........ | ........ | ........ | ........ |

of people that can be carried comfortably in a car seating 50. Table XLIX shows that this number was thought to be greater in winter than in summer; for a short ride rather than for a long one; when the majority of passengers are male rather than female; professional men rather than laborers; and teamsters rather than tannery or glue factory workers. The last is particularly striking and may serve as an illustration. The average person has a great dislike for strong odors of any kind, particularly strange and unusual ones. The words "tannery" and "glue" in the question immediately brought up to the minds of the students who answered the question a peculiar and disagreeable odor from which they would under ordinary circumstances try to move away. They, therefore, concluded that fewer people could be carried comfortably in a car seating 50 when the majority of the passengers were glue or tannery workers than when teamsters. The difficulty of basing loading standards on such an estimate of comfortable load conditions is immediately apparent and yet it is characteristic of many judgments too common to require further discussion.

It is often urged that a low fare is an essential of good service. Moreover, "low fares" has been a Cleveland slogan for the past eight or ten years and yet 50 per cent of the Cleveland answers as shown in Table L indicated a strong preference for good service as expressed in terms of frequent cars and the infrequent necessity of standing. In Milwaukee, the answers were clearly in favor of service first, less than 20 per cent preferring a low fare to good service. An analysis of the tabulated answers shown in Table L, reveals further that of those answering in both cities, 94 per cent did not hesitate to give as their unqualified opinion that the present rate of fare was profitable to the street railway company. Only 6 per cent had thought sufficiently about the matter to decide that it was unprofitable.[1]

The previous discussion of good service plainly indicates not only that it is impossible of exact measurement but that popular estimates may be expected to vary widely. The answers to the question "what is satisfactory service?", shown in Table LI indicate the difference of opinion as to factors affecting service. There were no less than 20 different suggestions offered, not a few of them contradictory to others. The answers illustrate various points of view and individual taste and suggest a variety of things from the present service and fare to an "elastic" transfer system. The majority emphasized frequency and regularity of service, sanitation, and comfort, but from the previous discussion it appears that the great majority of the attempts at definition of these determinants of the quality of service are indefinite and unsatisfactory.

[1] See Chapters XXII to XXVI and XXVII to XXIX for an analysis of the returns in the traction industry in Cleveland and Milwaukee.

Table XLIX — Factors Affecting the Maximum Number of People That Can be Carried Comfortably in a Car Seating Fifty.

| | Cleveland | Milwaukee | Combined |
|---|---|---|---|
| **Length of Ride** | | | |
| Total | 88 | 64 | 152 |
| Greater for 0.5 mile ride than for 3 mile ride | 61 | 38 | 99 |
| Less for 0.5 mile ride | 10 | 17 | 27 |
| No difference | 17 | 9 | 26 |
| **Sex** | | | |
| Total | 81 | 65 | 146 |
| Greater when majority male | 66 | 44 | 110 |
| Greater when majority female | 10 | 8 | 18 |
| No difference | 5 | 13 | 18 |
| **Class of Passengers** | | | |
| Total | 79 | 62 | 141 |
| Greater when majority laborers | 30 | 24 | 54 |
| Greater when majority professional | 45 | 24 | 69 |
| No difference | 4 | 14 | 18 |
| **Odors** | | | |
| Total | 37 | 44 | 81 |
| Greater when majority tannery workers | 9 | 6 | 15 |
| Greater when majority teamsters | 27 | 27 | 54 |
| No difference | 1 | 11 | 12 |
| **Season of Year** | | | |
| Total | 80 | 67 | 147 |
| Greater in summer | 15 | 19 | 34 |
| Greater in winter | 62 | 47 | 109 |
| No difference | 3 | 1 | 4 |

This illustrates clearly the customary methods of arriving at conclusions.

Table L — Rate of Fare vs. Service

| City | Opinions as to the profitableness of the present rate of fare to the street railway company | | | Low fare *vs.* service | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Frequency of service — Preference | | | | Available seats — Preference | | | |
| | Total | Profitable | Unprofitable | Total | Low fare | Fre-q'nt ser. | No choice | Total | Low fare | S'ts | No choice |
| Cleveland | 76 | 72 | 4 | 84 | 35 | 48 | 1 | 70 | 36 | 34 | ..... |
| Milwaukee | 63 | 58 | 5 | 70 | 7 | 61 | 2 | 64 | 13 | 49 | 2 |
| Combined | 139 | 130 | 9 | 154 | 42 | 109 | 3 | 134 | 49 | 83 | 2 |

It was thought that if difficulties were encountered in defining what good service is, it might be of assistance to have the students state why they were dissatisfied, if at all, with the present service, but it is worthy of note that only 4 out of 30 in Cleveland and 8 out of 27 in Milwaukee had any reason to offer for their dissatisfaction (Table LII). Further only 40 per cent of those answering expressed any dissatisfaction with the present service in Cleveland while 50 per cent did so in Milwaukee. Moreover, 52 per cent gave unqualified support to the present Cleveland service while in Milwaukee this percentage was only 22 per cent. At a matter of fact service in Milwaukee under the standards of the Railroad Commission of Wisconsin is in general

TABLE LI — WHAT IS SATISFACTORY SERVICE? — OPINIONS AS TO WHAT CONSTITUTES SATISFACTORY SERVICE.

| CITY | TOTAL | Sanitation and safety | | | | Frequency of service, total | Number of cars and seats, total | Regularity of service, total | Type of employes, total | Fares | | | Speed | | | Present fare and service, total | Good track, total | Appearance of cars total | Transfers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Ventilation | Lack of Accidents | Others | | | | | Total | Low | Reasonable | Total | High Running | Few Stops | | | | Total | Elastic System | Transfer on Transfer | Others |
| Cleveland...... | 229 | 54 | 20 | 2 | 32 | 46 | 33 | 13 | 22 | 30 | 23 | 7 | 12 | 8 | 4 | 4 | 6 | 5 | 2 | 1 | 1 | ... |
| Milwaukee..... | 172 | 37 | 12 | 1 | 24 | 35 | 29 | 31 | 15 | 11 | 6 | 5 | 9 | 8 | 1 | 2 | ...... | 1 | 4 | .. | .. | 4 |
| Combined...... | 401 | 91 | 32 | 3 | 56 | 81 | 62 | 44 | 37 | 41 | 29 | 12 | 21 | 16 | 5 | 6 | 6 | 6 | 6 | 1 | 1 | 4 |

fully the equivalent of that in Cleveland. Cleveland people, however, have been long educated to a belief in the superiority of their service and in the satisfactory results of "The Cleveland Plan." The long Cleveland controversy ended in 1909 had made it clear to them that low fares must go hand in hand with economies in operation such as result from less frequent service and fewer stops. As a result of this educational influence in Cleveland, the popular conception of the service there is "good" service. In Milwaukee, on the other hand, there had been some time prior to that of the test frequent newspaper agitation against the service of the utility during hearings on an appeal from an order of the Railroad Commission. This agitation has undoubtedly influenced the preponderance of the verdict that service is "poor."

Table LII — Is the Present Service Satisfactory

| City | Summary | | | | Satisfactory because of | | | | Unsatisfactory because of | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Yes | No | Partially so | No reason given | Rate of fare | Appearance of cars | Absence of published complaints | No reason given | Rate of fare | Appearance of cars | Published complaints |
| Cleveland | 77 | 42 | 30 | 5 | 7 | 40 | 34 | 20 | 26 | 3 | 4 | 3 |
| Milwaukee | 58 | 13 | 27 | 18 | 21 | 6 | 10 | 7 | 19 | 4 | 4 | 8 |
| Combined | 135 | 55 | 57 | 23 | 28 | 46 | 44 | 27 | 45 | 7 | 8 | 11 |

No discussion of the quality of service is complete without a consideration of the large influence of published complaints on opinion as to the character of service — another illustration of susceptibility to suggestion. Few will admit this and yet when the complaints are made by a public official a far greater weight is given to them than when made by a private citizen.[1]

An examination of the tabulated answers given in Table LIII shows this clearly. While only 32 per cent in Cleveland and 6 per cent in Milwaukee thought that published complaints as to the character of street car service would have an influence on their judgment, over 50 per cent in Cleveland and in Milwaukee admitted that this would be the case when such complaints were made by a public official.

1 One is most susceptible to suggestions from certain quarters or from certain people — from those clothed with prestige. Prestige is that which excites such wonder or admiration as to paralyze the critical faculty * * * Acquired prestige is that due to proximity, place, office, etc. * * * * The simpler and more dramatic or visually imaginable kinds of power have a permanent advantage as regards general ascendency. Ross, Social Psychology, pages 30–32.

TABLE LIII — INFLUENCE OF PUBLISHED COMPLAINTS ON OPINION AS TO CHARACTER OF STREET CAR SERVICE

| CITY | Weight given when made by private citizen | | | | Weight given when made by public official | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Yes | No | Partial | Total | Yes | No | Partial |
| Cleveland | 66 | 21 | 44 | 1 | 62 | 35 | 25 | 2 |
| Milwaukee | 65 | 4 | 48 | 13 | 63 | 28 | 31 | 4 |
| Combined | 131 | 25 | 92 | 14 | 125 | 63 | 56 | 6 |

The discussion has dealt thus far with the psychological factors entering into the judgment of the quality of street railway service and of the interest taken in it. It has been pointed out that the judgment of the average person as regards these factors is rather likely to be faulty because of inaccuracy of perception and because of susceptibility to impression and suggestion. It will be of interest now to note briefly the opinions and observations of the students as to the current local street railway practice.

The analysis of the answers to the question "Are conductors courteous and accommodating?" shown in Table LIV, indicates that while a majority gave either an unqualified or a qualified approval, there was still room for improvement. In general, about 60 per cent of those answering in both cities thought that conductors were either quite or partially courteous and accommodating because they held the car for tardy passengers to board or alight, helped passengers

TABLE LIV — ARE CONDUCTORS COURTEOUS AND ACCOMMODATING

| CITY | Answer | In holding car for tardy passengers to board or alight | In helping passengers with bundles | In calling streets | In Giving Information: Concerning the local transportation system | In Giving Information: Concerning points of interest in this city |
|---|---|---|---|---|---|---|
| Cleveland | Total | 65 | 65 | 69 | 59 | 50 |
| | Yes | 27 | 38 | 44 | 39 | 18 |
| | No | 28 | 22 | 20 | 14 | 28 |
| | Indefinite | 10 | 5 | 5 | 6 | 4 |
| Milwaukee | Total | 63 | 65 | 64 | 54 | 49 |
| | Yes | 36 | 38 | 28 | 34 | 19 |
| | No | 19 | 17 | 27 | 13 | 23 |
| | Indefinite | 8 | 10 | 9 | 7 | 7 |
| Combined | Total | 128 | 130 | 133 | 113 | 99 |
| | Yes | 63 | 76 | 72 | 73 | 37 |
| | No | 47 | 39 | 47 | 27 | 51 |
| | Indefinite | 18 | 15 | 14 | 13 | 11 |

with bundles, called out the names of the streets, and gave information concerning the local transportation system. The answers were about equally divided on the question of giving information concerning points of interest in the cities in question.

Opinions and observations with regard to miscellaneous practices (Table LV) vary as greatly as they do with regard to the matters previously discussed. These answers indicate that in Cleveland students looked first at the destination sign rather than at the route sign, while the opposite was true in Milwaukee. A very small percentage (about five per cent) in both cities looked at "either or both."

Ability to identify a car at a certain distance, here measured in blocks, depends upon two things: the type of sign in use and the eyesight of the individual. The average student in either city was able to distinguish his car about a block and a half away, the modal answer being one block. When there are considered, however, the maximum and minimum answers, a wide range is found. In Cleveland, the answers varied from 0.5 to 5.5 blocks, while in Milwaukee from 0.25 to 9.0 blocks. Such a variation indicates either abnormal eyesight or faulty perception of distance. In view of the foregoing discussion, one is inclined towards the latter alternative.

In many cities where there is no transfer charge, transfers are often requested, not because they are needed, but in order to give them to others, or to use them as fare receipts. Of the combined answers in Cleveland and Milwaukee, only 3 per cent admitted making unnecessary requests for transfers at the present time. However, prior to the making of a charge for transfers in Cleveland, this percentage was somewhat higher — about 15 per cent, while in Milwaukee the percentage of transfers not lifted is reported as 20 per cent for 1914.

Table LV

| City | Ability to distinguish one's car. Distance measured in blocks | | | | Route or Destination Sign First Observed | | | | Transfers | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Unnecessary requests at present | | | Unnecessary requests prior to charge for | | |
| | Average | Maximum | Minimum | Mode | Total | Destination | Route | Either or both | Total | Yes | No | Total | Yes | No |
| Cleveland | 1.5 | 5.5 | .5 | 1 | 87 | 62 | 23 | 2 | 76 | 3 | 73 | 70 | 10 | 60 |
| Milwaukee | 1.5 | 9 | .25 | 1 | 65 | 12 | 47 | 6 | 70 | 2 | 68 | .... | .... | .... |
| Combined | 1.5 | 9 | .25 | 1 | 152 | 74 | 70 | 8 | 146 | 5 | 141 | .... | .... | .... |

Opinion as to the convenient or reasonable walking distance to a car line or stop (measured in blocks) is given in Table LVI and differs as widely as in the cases of the other questions asked. The

reasonable distances were thought to be slightly smaller in Cleveland than in Milwaukee. In practice the reverse is true,[1] Cleveland distances being greater, due in part to the operation of a skip-stop plan. In each city the reasonable distances were thought to be shortest in the retail district and longest in the residential district with distances in the wholesale district between the two. The average distance to a car suggested as reasonable varied from 1 block in the retail district to 1.5 in the wholesale and between 2 and 3 in the residential district. The minimum distance suggested was 0.25 of a block and the maximum 5 blocks.

TABLE LVI — CONVENIENT OR REASONABLE WALKING DISTANCE TO A CAR STOP OR CAR LINE — MEASURED IN BLOCKS

| City | In residence district | | | | In retail or downtown district | | | | In manufacturing or wholesale district | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average | Maximum | Minimum | Mode | Average | Maximum | Minimum | Mode | Average | Maximum | Minimum | Mode |
| Cleveland...... | 2.3 | 5 | .5 | 2 | 1.0 | 2 | 0.25 | 1 | 1.5 | 4.5 | 0.25 | 1.0 |
| Milwaukee..... | 3.0 | 5 | 1.0 | 3 | 1.25 | 3 | 0.5 | 1 | 2.0 | 4.0 | 0.5 | 1.5 |
| Combined...... | 2.65 | 5 | .5 | 3 | 1.1 | 3 | 0.25 | 1 | 1.8 | 4.5 | 0.25 | 1.0 |

The diversity of popular opinion on trail car and center entrance car operation is indicated by the answers tabulated in Table LVII. In order to facilitate the solution of the ever-growing "rush-hour" problem, many street railway companies have made use of trailers of various types. Any innovation is likely to become a source of controversy and the use of trailer cars has not been an exception. The students were asked several questions designed to bring out the good and bad points of motor and trailer cars from the standpoint of the passenger. In Cleveland 56 per cent expressed a preference for the trailer car either at all times, during the rush hours, or when the car was less crowded; 7 per cent apparently had no preference as to the type of car they used, while 36 per cent preferred the motor car. In Milwaukee about 11 per cent preferred a trailer because it was more "comfortable" and "less dusty," while 54 per cent preferred a motor car for various reasons such as "less jolty," "not dusty," "two exits," "faster service" (*sic*) and "better ventilation." About 35 per cent of the Cleveland answers indicated no preference as between the P. A. Y. E. and P. A Y. L. end of the trailer,[2] 30 per cent preferred the former because it allowed easier exit, was more convenient or allowed the getting rid of the responsibility of paying the fare. On

[1] 27.5 per cent of the area of Cleveland and 18.2 per cent of the area of Milwaukee is over 1500 ft. from a car line and the mean distance of all points is 900 ft. from a car line in Cleveland and 800 ft. in Milwaukee.

[2] Chapter XXV, page 399.

## Table LVII — Practice as to Type of Car

**Trailer or Motor**

| City | Preference: Total | Preference: Trailer | Preference: Motor | Preference: No difference | When? Trailer: Total | When? Trailer: Always | When? Trailer: Never | When? Trailer: A. M. and P. M. | When? Trailer: Less crowded | Why? Trailer: Total | Why? Trailer: More comfort | Why? Trailer: Less danger | Why? Motor: Total | Why? Motor: Less jolts and dust | Why? Motor: Two exits | Why? Motor: Faster service |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cleveland | 68 | 38 | 25 | 5 | 31 | 10 | 4 | 7 | 10 | .. | .. | .. | .. | .. | .. | .. |
| Milwaukee | 66 | 7 | 36 | 23 | .. | .. | .. | .. | .. | 5 | 4 | 1 | 22 | 12 | 3 | 7 |
| Combined | 134 | 45 | 61 | 28 | 31 | 10 | 4 | 7 | 10 | 5 | 4 | 1 | 22 | 12 | 3 | 7 |

**P. A. Y. E. end or P. A. Y. L. end**

| City | Preference: Total | Preference: P. A. Y. E. | Preference: P. A. Y. L. | Preference: No difference | Why? P. A. Y. E.: Total | Why? P. A. Y. E.: Easier exit | Why? P. A. Y. E.: Rid of responsibility | Why? P. A. Y. E.: Habit | Why? P. A. Y. E.: Convenience | Why? P. A. Y. L.: Total | Why? P. A. Y. L.: Easier payment of fare | Why? P. A. Y. L.: Easier entrance and exit | Why? P. A. Y. L.: Convenience |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cleveland | 78 | 23 | 42 | 13 | 19 | 8 | 4 | 3 | 4 | 31 | 19 | 7 | 5 |
| Milwaukee | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Combined | 78 | 23 | 42 | 13 | 19 | 8 | 4 | 3 | 4 | 31 | 19 | 7 | 5 |

**Center entrance or End entrance**

| City | Preference: Total | Preference: Center entrance | Preference: End entrance | Preference: No difference | Why? Center: Total | Why? Center: Easier entrance and exit | Why? Center: Lower steps | Why? Center: Less confusion | Why? Center: Distribution of load | Why? Center: Convenience | Why? End: Total | Why? End: Less confusion | Why? End: Less congestion | Why? End: More room in center | Why? End: More side seats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cleveland | 75 | 46 | 19 | 10 | 38 | 19 | 5 | 2 | 4 | 8 | 9 | 6 | 1 | 1 | 1 |
| Milwaukee | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Combined | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

the other hand, about 54 per cent of the Cleveland answers indicated a preference for the P. A. Y. L. end of the trailer because of easier exit and entrance, convenience, easier paying of fare and, as one student ingenuously put the matter "because you don't have to pay the fares of your companions"; 16 per cent of the Cleveland answers expressed no preference for either type.

A majority of the Cleveland answers (61 per cent) indicated a preference for the center entrance type of car because it allowed easier entrance and exit, had lower steps, was more convenient and distributed the load more uniformily and with less confusion. About 25 per cent favored the end entrance type of car because there was less confusion, less congestion in center and because it had more side seats.

It is apparent from the above answers that the opinions express individual preference, are variable and contradictory and no definite conclusions can therefore be drawn.

The responses to questions as to street railway service in other towns were, in general, unsatisfactory, and owing to the evident limitations of the memory of impressions are not tabulated. Fifty-five of the students in Cleveland reported impressions of service rendered in 29 other cities and 47 students in Milwaukee reported upon their impressions in 25 other cities. To the question as to whether service rendered in such cities was satisfactory 16 students in Cleveland reported yes and 29 no, while 32 students in Milwaukee reported yes and only 3 no. Upon the question as to whether the rate of fare in such cities was profitable 63 reported that in their judgment it was, and only one that it was not.

## Conclusions

The general conclusions which may be drawn from the study follow:

(1) The sense perception of time and number of street car patrons is subject to the usual inaccuracies observed in experiments of psychologists in other fields. The application of this fact to opinion testimony of car patrons as to service requires no comment.

(2) Impressions of street car patrons as to service are influenced in part by suggestion. It is probable that the influence of suggestion would be heightened if it were possible to conduct tests not in the class room without intercommunication, but in the street car, where the psychology of the crowd would find full play. Individual judgments disclose such variation that their reliability and usefulness may be questioned.

(3) The knowledge as to technical details of operation is limited and expressions of opinion as to the advantages of operating practices are varied and confused.

(4) If majority rather than individual opinion of service is a criterion of what is a reasonable and adequate service standard, important modifications are necessary in standards of service so far promulgated by commissions based upon ratio of passengers to seats.

## APPENDIX TO CHAPTER XIII.

### SCHEDULE OF QUESTIONS — PSYCHOLOGICAL SURVEY OF STREET CAR PATRONS

(Questions A-1 to J inclusive, asked both in Cleveland and Milwaukee.)

A. 1. In Residence Districts how long would you expect to wait for a car:

(*a*) When service is excellent..........................

(*b*) When service is good..............................

(*c*) When service is fair...............................

(*d*) When service is poor...............................

2. In Down-town District how long would you expect to wait for a car:

(*a*) When service is excellent..........................

(*b*) When service is good..............................

(*c*) When service is fair...............................

(*d*) When service is poor...............................

B. Would you modify your conclusions expressed in the questions A-1 and A-2 above, and to what extent, (great, little, not at all) if you took into account:

(*a*) Duration of intended ride..........................

(*b*) The destination or purpose of the ride as — To the university, to a theatre, etc....................

C. To what extent (great, little, not at all) does weather — (cold, hot, wet) — affect your judgment as to a reasonable length of time you should wait for a car:

(*a*) Where service is excellent.........................

(*b*) Where service is good.............................

(*c*) Where service is fair..............................

(*d*) Where service is poor.............................

D. What do you consider to be the maximum number of people that can be carried comfortably in a car seating 50?

(*a*) During the morning...............................

(*b*) During the middle of the day.......................

(*c*) During the evening................................

(*d*) Would your answers to the above questions be greater or less for a ride of 0.5 mile than for a ride of 3 miles .........................................

(*e*) What proportion of standing to seated passengers would you regard as good service?........per cent.

(*f*) Is your answer to the above question determined by the number of passengers which made the car uncomfortable........................... or by some other impression as..............................

**E.** 1. Do you look first for route sign or destination sign on cars? For instance, if you were down-town and wished to take a car to the University on a street where cars of a number of lines run, in determining the car which you are to board, do you note first the destination sign which says Collinwood, Euclid Village, E. 140th St., etc., or do you note first the route sign which says Euclid........................................

Note.— Illustration changed for Milwaukee.

2. How far away can you distinguish your car?..........Blocks.

**F.** Consider the maximum number of passengers constituting a comfortable load.

(*a*) Is this number greater when the majority of passengers is of the male sex or of the female sex ..........................................

(*b*) Laborers or professional men.......................

(*c*) Tannery or glue factory workers, or teamsters.......

(*d*) Is the number of passengers constituting a comfortable load greater in summer or winter..........

**G.** Do you regard the money saving resulting from low fares as *more* important than:

(*a*) Frequency of service...............................

(*b*) Frequency with which you are obliged to stand in car ..........................................

**H.** 1. Do you regard the service in this city as satisfactory?

(*a*) Is this view based on the rate of fare?........... (weight)...........

(*b*) Is this view based on appearance of cars?........... (weight)...........

(*c*) Is this view based on absence of published complaints?...........(weight)...........

Note.— In answering these questions indicate by 1 the factor which is given the greatest weight, by 2 the factor given next weight and by 3 the factor given least weight.

2. What is your conception of satisfactory service?.............
3. In your opinion is the present rate of fare in this city profitable to the company which owns the street railway?.............
4. Do you ever discuss the subject of street car service with others?...........
5. If so, is the discussion with another passenger on the car...... or with friends at home and about the neighborhood in which you live?...........

**I.** 1. How long do you ordinarily wait for a car?

(*a*) In the morning...........

(*b*) In the middle of the day...........

(*c*) In the evening...........

2. Do you have to wait longer for cars in the winter than in the summer?............

3. Is the time between consecutive cars *greater* or *less* in stormy than in good weather?....................................

J. How often do you customarily ride on street cars?..............
(Questions K to P inclusive, as asked in Cleveland.)

K. 1. When you ride on a trailer car do you prefer the pay-as-you-enter to the pay-as-you-leave end of the car?..............
Why?.................. . . ...................................

2. Do you prefer trailer car to motor car?.........................
When?..................... . . ............................

3. Do you prefer center-entrance to end-entrance cars?..........
Why?.................. . . ...................................

Note.—If you have no preference and customarily take either type of car without thought, so state.

L. 1. Do you request transfer even though your journey does not require its use?............ Did you request transfer under similar conditions before charge was made?................

M. What is a reasonable or convenient walking distance to a car stop or car line?
(*a*) In residence district............blocks.
(*b*) In down-town or retail district............blocks.
(*c*) In manufacturing or wholesale district............ blocks.

N. Do you regard the conductors as courteous and accommodating? If so, specify under following heads:
(*a*) Holding car for tardy passengers to board or alight ............
(*b*) Helping passengers with bundles............
(*c*) Calling streets............
(*d*) Giving information concerning the local transportation system............
(*e*) Giving information concerning points of interest in this city............
(*f*) Others...................... . . . ...................

O. 1. If you saw frequently in the daily papers published complaints as to the street car service, but were without personal knowledge in respect thereto, would these published complaints have any influence on your opinion as to character of service?......

2. If the complaints were by a city official would you give them more weight in forming your opinion than if they were made by a private citizen?............

P. 1. Have you ridden in cars in another city within the last year?............

2. If so, state name of city............

(In Milwaukee, Questions K to P inclusive, were asked in the following form.)

**K.** Do you prefer trailer car to motor car?.............................
Why?..............................................................

Note.— If you have no preference and customarily take either type of car without thought, so state.

**L.** Do you request transfer even though your journey does not require its use?..............................................

**M.** What is a reasonable or convenient walking distance to a car stop or car line?
(*a*) In residence district............blocks.
(*b*) In down-town or retail district............blocks.
(*c*) In manufacturing or wholesale district............ blocks.

**N.** Do you regard the conductors as courteous and accommodating? If so, specify under following heads:
(*a*) Holding car for tardy passengers to board or alight............
(*b*) Helping passengers with hundles............
(*c*) Calling streets............
tion system............
(*e*) Giving information concerning points of interest in this city............
(*f*) Others ..............................................

**O.** 1. If you see in the daily papers published complaints as to the street car service, but are without personal knowledge in respect thereto, do these published complaints have any influence on your opinion as to character of service?..................
2. If the complaints were by a city official would you give them more weight in forming your opinion than if they were made by a private citizen?............

**P.** 1. Have you ridden in cars in another city within the last year?............
2. If so, state name of city............

(Questions HH to JJ inclusive, as asked in Cleveland and Milwaukee.)

(The three following questions, HH, II, JJ, to be answered only by students who have ridden on street cars in other cities during the past year.)

**HH.** 1. Do you regard the service in that city as satisfactory?........
(*a*) Is this view based on the rate of fare?............ (weight)............
(*b*) Is this view based on the appearance of cars?........ (weight)............
(*c*) Is this view based on absence of published complaints?............(weight)............

Note.— In answering these questions indicate by 1 the factor which is given the greatest weight, by 2 the factor given next weight and by 3 the factor given least weight.

2. In your opinion was the rate of fare in that city profitable to the company which owned the street railway?............
3. Did you ever discuss the subject of street car service with others?............
4. If so, was the discussion with another passenger on the car............or with friends............

II. How long did you ordinarily wait for a car in that city?
   (a) In the morning............
   (b) In the middle of the day............
   (c) In the evening............

JJ. How often did you customarily ride on street cars in that city?............

# PART IV.

## SPECIAL PROBLEMS

# CHAPTER XIV

## THE PAYING HAUL — COST OF EXTENDING FARE LIMITS AND LINES

Effect of Expansion of Cities on Area Served for Single Fare, —— Relation of Extensions of Passenger Haul to Other Service and Cost,—— Methods Proposed for Determining Paying Haul, —— Ford "Car Mile" Formula,—— Bradlee "Car Haul" Formula, —— "Load Factor" Formula of C. N. Duffy,—— Typical Problems Analyzed: (1) Cost of Extending Single Fare Point into Second Fare Zone; (2) Cost of Extending Existing Line by Construction,—— Determination of Paying Haul upon Passenger Haul or Car Haul Basis.

With few exceptions, American cities have grown rapidly and steadily in area for many years. It is a matter of common experience that the suburban community of one decade lies within the city limits of the next. This growth is very largely the result of the existence of transportation systems which have, by increased schedule speeds, brought the suburbs many minutes nearer to the center of the city. Concurrently with this growth the electric railway operator is confronted with the problem of the establishment of the limits within which a single fare will apply. Obviously, there is no reason that, with the annexation of suburbs, there should be coincidence between fare limits and city limits. In many instances, as is well known, city limits are determined not by the size or the social characteristics of the community center, but by political expediency. It is apparent then that fare limits must frequently be established which do not find their position determined by the boundaries of civil divisions.

It is evident that the distance to which it is possible to haul a passenger for a single fare must be determined upon the basis of cost of service and that any attempt to extend service beyond the point where such service ceases to pay must result ultimately in the deterioration of the service.

The purpose of the present study is to examine methods of determination of the economic limit of passenger haul for a single five-cent fare. The succeeding study will take up the question of fares for passenger haul in the zones outside the central or metropolitan area. It is obvious that it is possible, if desired, to limit the single fare or central zone to a more restricted area involving lower rates of fare such as four cents or three cents for such restricted service with added increments of fare for outlying areas. This would involve an analysis of the costs of a zone system similar to that used in England and on the Continent.

The general discussion in this chapter may be illustrated by two practical problems affecting a typical urban street railway, which may be stated as follows:

(1) What will be the cost to the company accruing from the moving of the single fare limit on an existing line in such a manner that the length of possible haul will be increased one mile?

(2) What will be the cost to the company accruing from the extension of an existing line now terminated at the single fare limit by the construction of additional track and distribution line one mile into new territory, with a corresponding extension of the single fare limit to the new terminus.

Before giving attention to these typical extensions of service it is necessary to have in mind the relation that any addition in service area has to the traction system as a whole. Some of these relations are evident from preceding discussions. These and others may be briefly summarized under the following headings:

### Relation of Increased Passenger Haul to Traffic in the Central Area.

The addition of tributary passengers in the suburb to the traffic within the single fare or central area results in increased haul per average passenger and increased density of traffic.[1] Therefore, the addition of suburban service for the same fare has an important influence upon the total cost of service, aside from the added costs determined for the extension.

### Relation of Passenger Haul on Single Lines to Passenger Haul on Contiguous Lines.

No single line can have its fare limits extended without diverting traffic from contiguous lines. Where single extensions are attempted it is found that long haul traffic is attracted from surrounding territory

---

[1] This is brought out in the case of Cusick, et al., *vs.* T. M. E. R. & L. Co., et al., involving the extension of single fare point to West Allis, a suburb of the city of Milwaukee, in which the Railroad Commission of Wisconsin states:

"From an examination of net earnings by lines contained in the case City of Milwaukee v. T. M. E. R. & L. Co., 1912, 10 W. R. C. R., 1, and from a study of the traffic demands by lines contained in the report submitted by the engineer of the Commission, it appears that the service in question is a continuation of city business and more closely allied to urban rather than interurban traffic. City lines having suburban outlets are as a rule upon a better paying basis than city lines without such an outlet. Generally speaking, increased density of traffic in the suburbs is accompanied by increased density of traffic within the city. The number of persons riding upon the car, it appears, is closely related to the population per tributary quarter square mile, and just as increased density of population within the city means a related increase at the outskirts, so it appears that the demand for service within the city is proportionately increased by the demand for service at the suburbs. The suburban or second fare zone is undoubtedly entitled to share the benefits of the increased traffic it occasions upon city lines." 10 W. R. C. R. 332, 333.

It is apparent from chapter 16, "Cost of Complying with Service Standards," that the disadvantages of increased traffic under many conditions of operation outweigh the benefits.

The effect of added suburban traffic on density of city traffic is commented upon in the recent report of the Special Subcommittee of the City of Manchester, The Passenger Transportation Problem, page 4, as:

"*Extension of transit facilities to outer zones increases the difficulties in central zone.*—Every extension of the means of transit into the outer zones adds to the difficulties of handling the traffic in the central zone, and in time the congestion becomes so acute that the city authorities realize they are face to face with the inevitable traffic problem. This condition of things arises sooner or later in all large cities, but some cities have been confronted with the problem at an earlier date than others owing to the narrowness and bad layout of the streets in the older parts of the city, to the absence of suitable arterial roads, and to the presence in the central zones of a large amount of ordinary vehicular traffic, which, if it is slow-moving, tends to retard the general flow of the traffic."

to the disadvantage of lines with established headway but with higher fares for the long haul service. The effect of this influence depends upon the walking distance from the line extended.

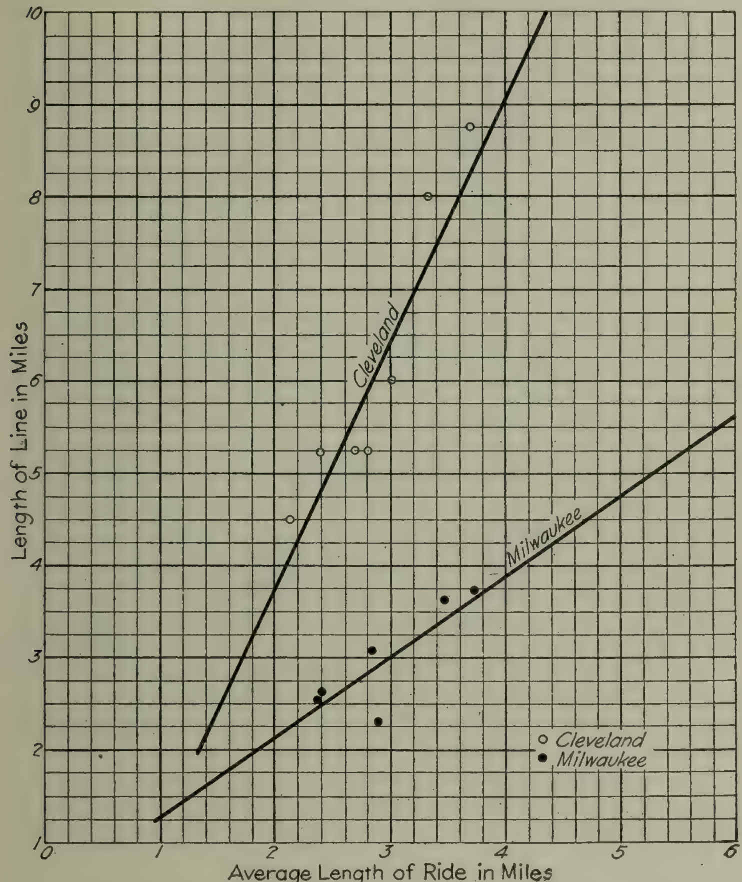



Fig. 34.— Relation Between Length of Ride and Length of Line (Cleveland), and Length of Ride and Length of Half Round Trip (Milwaukee).

Relation of Passenger Haul on Suburban and Interurban Lines to City Lines.

There is no abrupt transition from suburban service to city service or from suburban service to interurban service, since upon any line the characteristics which may define these types of service are gradu-

ally encountered as the line is traversed from the center of the city to its outlying terminus.[1] Costs peculiar to interurban or suburban service can rarely be applied to the extension in question without relation to total costs of service.

### Relation of Passenger Haul to Length of Line.

There appears to be a functional relationship between length of passenger haul and the trip distance or length of line. This is evident from Fig. 34. This relationship is important as it permits the computation of cost of extended service upon either the basis of length of passenger haul, where the actual passenger haul can be determined, or the length of car haul.

### Relation of Passenger Haul to Cost.

The conditions enumerated above, indicate the close relationship of service on extended lines to other service, and must all be reflected in any reliable analysis of cost. There are additional limitations arising out of the nature of the costs themselves which must be taken into consideration. These may be stated as follows:

(1) It is evident from previous discussions[2] that the cost of service does not vary directly with the length of ride although certain elements which make up total cost vary with the length of passenger or car haul. A portion of the costs is fixed or independent of traffic and a portion varies with the extent of traffic.

(2) The actual costs on any line or extension of line may be expected to vary greatly due to physical characteristics such as expensive fills, viaducts, etc. Were fares based upon actual cost the more expensive line would be permanently at a disadvantage in securing business. Estimates of the paying haul in any direction from the center of the city must be based upon average costs rather than upon cost incurred specifically upon separate lines.

Several methods have been proposed for calculating the paying haul per passenger. These have been enumerated and discussed in the preliminary report of the Bureau of Fare Research[3] and are properly included here.

(A) In his memorandum[1] attached to the 1911 report of the Com-

[1] From a territorial viewpoint, the city ordinarily merges into its next adjacent suburb without sufficient changes in the character of community improvements to enable one to determine that he is passing beyond the bounds of one municipal jurisdiction into those of another. The outer limits of suburban communities usually possess little that distinguishes them from the rural community into which they merge. Interurban lines are actually built or operated as extensions of suburban lines which in turn are extensions of city lines. It is difficult, if not impossible, to accurately define urban, suburban and interurban territory because they merge into one another as day into twilight and night. In fact, it is questionable whether such definition is either desirable or necessary for electric railway purposes. R. B. Stearns, "A Zone System of Fares in Practice." 1914, *Proceedings American Electric Railway Association*, pages 236, 237.

[2] Chapter VII, "Units of Comparison."

[3] Aera, June and July, 1914.

mittee on Determining the Proper Basis of Rates and Fares, Mr. Frank L. Ford has suggested a method of calculation, based upon the passenger mile, and points out its application to a zone system of fares:

From a study of the methods used in the past history of this industry and from observation of traffic conditions and rates upon city electric railways, the following method would seem to be a practical solution of the problem:

(1) Determine for each line the distance for which the cost of service per passenger mile on that line (including a reasonable return on investment) equals the receipts per passenger mile at five cents per passenger, or the base rate of fare.

(2) For each line fix the limit of a central five-cent fare zone which will result in an average length of ride equal to this distance.

(3) Adjust the limits of this central zone to correspond with a practical point for each line. In order to work out a practical system, some lines will, of course, show a loss in operation which must be balanced by an excess profit on others.

(4) For the portions of lines outside of this central zone construct outlying three-cent fare zones, calculating the distance on each line for which such additional fare would equal the total cost of service. It is believed that the rate of fare for outlying zones as a matter of expediency, should be less than five cents and also that one cent or two cents additional fares for such zones would not usually be desirable on account of the inconvenience of the additional payment for the short ride involved. The local ride in such outlying zones would cost five cents.

(5) With regard to transfers both in the central and outlying zones, either free transfer or transfer at a charge equal to the outlying zone fare could be used, depending on the area to which it was found desirable to extend the zone limits. In other words, a charge of three cents for a transfer would permit of considerably larger zone areas than with free transfers, and in many cases the charge for transfers would eliminate the necessity of establishing the outlying zone. On the other hand, the use of free transfers has tended to stimulate traffic and with a high enough rate of fare has some desirable features. If three-cent tickets for outlying zone fares and three-cent transfers were used, the same ticket might be interchangeable.

## Many Difficulties Present Themselves

The comprehensive nature of this problem and the difficulties in the way of working out a schedule of rates for any electric railway system will be appreciated when it is considered that there are required the following determinations:

(1) The amount of investment or value of the property upon which a return must be earned unless the amount of outstanding securities be used.

(2) The reasonable rate of return on this capital value, unless the interest and dividend rates of outstanding securities be used.

(3) Division between lines on the passenger mile basis of operating expenses and return on investment, with corrections where desirable for speed and weight of cars and for segregation of physical property.

---

[1] Memorandum by Frank R. Ford, to the Committee on Determining the Proper Basis of Rates and Fares of the American Electric Railway Association, Thirtieth Annual Conention, 1911.

(4) For each line the length of average ride which will yield a reasonable profit at five cents or other base rate of fare, deriving zone limits for each line corresponding with the maximum ride allowable for these fares.

As applied to assumed quantities the process would be as follows:

| | |
|---|---|
| (*a*) Cost of service per annum (including fixed charges and return upon the investment) | $100 000 |
| (*b*) Revenue passengers carried per annum | 2 000 000 |
| (*c*) Average haul per revenue passenger | 3.5 miles |
| (*d*) Revenue passenger miles per annum (b x c) | 7 000 000 |
| (*e*) Cost of service per revenue passenger | 1.43 cents |
| (*f*) Average fare per revenue passenger (Assumed) | 4.90 cents |
| (*g*) Length of paying haul per revenue passenger (f ÷ e) | 3.43 miles |

Under the conditions assumed above, an existing line upon which a revenue passenger is hauled an average of 3.5 miles would be justified in drawing in the single fare point, or center zone, so as to reduce the average haul to 3.43 miles, or an extension of an existing line would have its fare points determined after merging added costs and added passenger miles to the total costs and passenger miles of the entire line.

Two important objections have been raised against the application of such a plan.

(1) Operating expenses do not depend entirely upon passenger miles, and in determining the profitableness of new extensions, where traffic is small and fixed charges heavy, the application of the passenger mile treatment would result in an understatement of the cost involved in making the extension.[1]

---

[1] This is recognized in the joint report of conferees upon rapid transit development in New York, in which it is suggested that the passenger mile basis of apportioning expenses be applied to only such expenses as cannot be definitely localized:

"The conferees have given a great deal of attention to this problem in an endeavor to find a method of financing the operation of extensions that would be both fair to the operator and fair to the future growth of the city. If the income credited to an extension is the fare collected at its stations, and if the amount charged against it is the proportionate expense of the car miles operated on the extension, then it is not fair because it leaves the company with the full benefits of the increase of short haul profits, and it leaves the city to the indefinite payment of deficits. The conferees have concluded that the income and expense of each segregated extension should be that proportion of the whole income and expense which the fares collected on the extension bear to the total fares collected on the system. This is the so-called per passenger method of estimating expense in contradistinction to the socalled per mileage method.

The per passenger method of estimating expense applies only to that part of the expense of an extension that cannot be localized. Every extension has to stand on its own bottom as to the interest on the cost of its construction, manning stations, repairs to track and stationary equipment, and accidents on that extension. The per passenger method divides the general expenses of operating the system and moving its cars, so that these general expenses that cannot be localized are divided in the same ratio between the extension and the whole system as the fares are divided. This method brings to the aid of the extension, part of the excess earnings of the short hauls.

It has been worked out by application to many cases and shows that the outcome is not unfair to the operator or over-generous to the extension. The extension always will have the smaller earning power, yet will need to stand localized burdens of interest, manning and repairs. The per passenger basis does not put the extension on an equal footing with original lines, but simply divides the non-localized expense so that part of the profits of the short hauls help to support the extensions. The Brooklyn Rapid Transit Company has adopted this method in its last proposal." (New York Public Service Commission, First District, 1911, Vol. 1, page 477, Joint Report of Conferees, June 3, 1911, Appendix XII.)

(2) The basis of measurement is not definite. To provide for an average haul of 3.5 miles per passenger may take five miles of route. An inspection of typical car loading curves indicates that the average haul in any direction is not measured from the center of the zone, but from a dischargal area of varying width upon different lines. Even where extensive passenger traffic data is available, therefore, the geographical placing of fare points becomes a matter of judgment from the facts in hand. This will, of course, be true of any determination of the zone in which the single fare is properly applied, since a strict application of cost of service to each line would result in an impracticable, irregular area, in which paying lines would be extended, and losing lines contracted until there would result abnormal distortions in traffic density.

(B) Unlike the passenger mile or Ford formula, as it has been referred to, the basis suggested by Mr. Bradlee[1] considers the paying haul upon the car rather than upon the passenger basis. The factors entering into this calculation are as follows:

*First.* The total cost per car mile of operating expenses, exclusive of taxes, depreciation and obsolescence;

*Second.* The average number of five-cent fare passengers carried per half-round trip;

*Third.* The investment made in the Company's property for each one dollar of gross business;

*Fourth.* The percentage return on the Company's investment which must be earned to provide for taxes, depreciation and obsolescence, and attract capital freely to the business.

As applied to assumed quanities the process may be illustrated as follows:

| | | |
|---|---|---|
| (*a*) Cost of service per annum (including fixed charges and return upon the investment) | | \$100 000 |
| (1) Operating expenses (exclusive of taxes, depreciation and obsolescence) | \$48 000 | |
| (2) Fixed charges (taxes, depreciation and obsolescence, and return on investment) | 52 000 | |
| (*b*) Car miles per annum | | 320 000 |
| (*c*) Operating expenses per car mile ($a(1) \div b$) | | 15 cents |
| (*d*) Length of one-half trip | | 4.7 miles |
| (*e*) Revenue passengers per one-half trip | | 24 |
| (*f*) Passenger revenue per one-half trip (*e* x 4.90 cents per passenger) | | \$1.18 |
| (*g*) Investment per \$1.00 operating revenue | | \$4.00 |
| (*h*) Fixed charges (taxes, depreciation and obsolescence, and return on investment) per \$1.00 operating revenue (13% of *g*) | | \$0.52 |

[1] Memorandum by H. G. Bradlee, to the Committee on Determining the Proper Basis of Rates and Fares of the American Electric Railway Association, Thirtieth Annual Convention, 1911. See also Thirty-first Annual Convention, 1912.

(*i*) Amount of passenger revenue per one-half trip available for operating expenses (48% of *f*) .............. $0.57
(*j*) Paying haul per one-half trip per car ($i \div c$) ........ 3.7 miles

In brief the process consists of assessing each dollar of revenue with the same proportion of fixed charges, and of providing that ordinary operating expenses be pro-rated on a car mile basis. Under the conditions assumed, the reasonable distance which it is possible to run a car is 3.7 miles, whereas the present trip distance from the center of the line is 4.7 miles.

Mr. Bradlee, in the supplementary memorandum contained in the 1912 Committee Report, has applied his suggested process to twenty selected electric railways. The results disclose maximum half-trip lengths in miles, ranging from 1.71 to 4.54 miles, as applied to nine companies with annual gross receipts of over $1 000 000;—2.24 miles for one company in the revenue grouping of from $750 000 to $1 000 000;—2.02 miles and 3.22 miles for two companies within the revenue grouping, $500 000 to $750 000;—1.21 to 2.51 miles for four companies with revenues from $250 000 to $500 000; and 1.23 to 2.88 miles for four companies with gross receipts less than $250 000 per annum.

The objections which have been made to this suggested method are:

(1) The distribution of fixed charges upon the basis of revenue obviously does not place upon new extensions the full cost applicable thereto. Many extensions exist which involve heavy investments for the revenue obtained, being as high as $10 for each dollar of operating revenue instead of the average of $4 assumed in the illustration.

(2) Many ordinary operating expenses are more properly distributed upon some other than the car mile unit.

(C) Mr. C. N. Duffy[1] has pointed out that the proportion of costs attributable to terminal and movement expenses, according to the scheme of analysis as developed by the Wisconsin Railroad Commission is dependent upon the load factor, that is, the ratio of the number of passengers to the maximum seating capacity of the cars. The various cost items in the Milwaukee[2] case were as follows:

(*a*) Expenses which exist even though there is no traffic (terminal cost):

(1) Expenses varying with the miles of track operated.
(2) Demand expenses at power plant.
(3) Depreciation due to causes other than traffic.

(*b*) Expenses proportional to traffic (terminal or movement cost dependent upon load factor):

(1) Expenses varying with the car miles run.
(2) Expenses varying with the car hours run.
(3) Output expenses at power plant.
(4) Depreciation due to traffic.
(5) Return upon investment.

---

[1] C. N. Duffy, "Effect of Load Factor on the Cost of Electric Railway Passenger Service," Fourth Annual Mid-Year Conference, American Electric Railway Association, 1913.
[2] City of Milwaukee *vs.* T. M. E. R. & L. Co., 10 W. R. C. R. 1.

(*c*) Expenses proportional to number of passengers (movement cost):

(1) Expenses varying with the number of passengers carried.

(*d*) Administrative expense burden pro-rated to the above groups.[1]

The fixed or terminal costs as pointed out by Mr. Duffy being all the costs in group (*a*), plus (100-$x$) times the costs in group (*b*), where $x$ is the load factor, and the variable or movement costs being all the costs in group (*c*), plus $x$ times the costs in group (*b*), the percentage of the total cost which would be classed as fixed or terminal costs might range from 84 to 10 per cent, dependent upon the load factor, and where the total fare is five cents, the maximum possible haul in the example cited might range from 1.36 to 8.88 miles.

Like the method suggested by Mr. Ford, the Wisconsin method relates to a paying haul per passenger rather than to a paying haul per car. With the same assumed quantities used in illustrating the "passenger mile" basis and the "car haul" basis the process of calculation may be illustrated as follows:

| | | |
|---|---|---|
| (*a*) Cost of service per annum (including fixed charges and return upon the investment).................. | | $100 000 |
| (1) Costs independent of traffic........ | $10 000 | |
| (2) Costs proportional to car movement. | 82 000 | |
| (3) Costs proportional to passengers carried ................................ | 8 000 | |
| (*b*) Revenue passengers carried per annum.............. | | 2 000 000 |
| (*c*) Average haul per revenue passenger................. | | 3.5 miles |
| (*d*) Revenue passenger miles per annum ($b$ x $c$)......... | | 7 000 000 |
| (*e*) Car miles per annum.................................... | | 320 000 |
| (*f*) Seats per car (including standing by preference).... | | 48 |
| (*g*) Seat miles per annum ($e$ x $f$).................... | | 15 360 000 |
| (*h*) Load factor ($d \div g$).................................. | | 46% |
| (*i*) "Terminal" cost $a(1)$ + 54% $a(2)$................ | | $52 280 |
| (*j*) "Movement" cost 46% $a(2)$ + $a(3)$.............. | | $47 720 |
| (*k*) "Terminal" cost per revenue passenger ($i \div b$)... | | 2.62 cents |

[1] The accounts entering into the various groupings were as follows:
(a) Expenses which exist even though there is no (traffic terminal cost):
 (1) Part of way and structures accounts.
 (2) Part of power accounts.
 (3) Depreciation due only to deterioration caused by the ravages of time and the effects of the elements, obsolescence and supersession.
(b) Expenses proportional to traffic (terminal or movement cost dependent upon load factor):
 (1) Part of way and structures accounts.
 (2) All equipment accounts.
 (3) Part of power accounts.
 (4) Part of operation of cars accounts.
 (5) Depreciation due only to wear and tear.
 (6) Return on investment.
(c) Expenses proportional to number of passengers (movement cost):
 (1) All traffic accounts.
 (2) Part of operation of cars accounts.
 (3) Part of undistributed accounts (injuries and damages).
(d) Administrative expense burden:
 (1) All general and miscellaneous accounts.
 (2) All of undistributed accounts except injuries and damages.
 (3) Contingencies (extraordinary).
 (4) Taxes.

(*l*) "Movement" cost per revenue passenger mile ($j \div d$) 0.67 cent
(*m*) Average fare per revenue passenger (assumed).... 4.90 cents
(*n*) Length of paying haul per revenue passenger ($m - k$) $\div$ $l$.................................. 3.42 miles

The criticisms which have been made of the method suggested by the Railroad Commission of Wisconsin may be summarized as follows:

(*a*) Similar to the objection referred to, with regard to the passenger mile basis of Mr. Ford, the application of passenger mile basis to the length of car haul is not always definite.

(*b*) The scheme of analysis is complex and involves many separations of items which form a small portion of the total cost and which, therefore, do not materially affect the conclusions.

(*c*) The grouping of expenses employed in many instances proceeds on debatable ground. The grouping of return upon the investment as an item of cost proportional to traffic has been particularly questioned.

It appears from the foregoing discussion of general principles involved and methods pursued in computing paying haul that the problem is one of allocating total costs of service in accordance with the units of service contributed by any contemplated increase in the area served. In Chapter VII, "Units of Comparison," the distribution of costs for analysis on the basis of functional units has already been discussed and the method of regrouping expense items in the Interstate Commerce Commission classification of accounts has been outlined. The application of these unit costs may be illustrated by the two typical examples already referred to.

I. It is assumed that in a certain city the fare limits have been established at approximately equal distances from the traffic center so that the fare limits describe a roughly symmetrical inner zone. The length of ride on the several lines for one fare is not greatly different. The revenues of the company while not reasonably adequate, yield a return of seven per cent upon the investment, or above the average for the traction industry. In this city, then, there occurs a movement looking toward the extension of some or all of these fare limits. The question raised is the cost to the company of making the extension.

The city has a population of about 125 000. The electric railway operates 75 miles of line, all of which is double track. On the 150 miles of track there are operated regularly 250 cars, this being the maximum number in service at one time, on normal schedule. Two hundred and seventy-five cars are owned. The reserve is necessary to permit general overhauling of equipment from time to time and to meet extraordinary traffic conditions. One of the lines of this company extends at present five miles from the center of the city, ending in a sparsely settled suburban district. The present single fare limit is three miles from the city end of the line and coincides with the city limits. There is under way the annexation of a portion

of the territory through which the line passes, and if this is brought about, the city limits will be four miles from the center of the city on this line. If the single fare limit is made to correspond with the city limits, one mile of line will be taken from the second fare zone and added to the single fare zone.

Under the present conditions of operation, the annual revenues of the company are \$2 000 000,[1] and due to favorable density of traffic the investment amounts to \$4.25 per dollar of operating revenue. Operating expenses, including reserves for replacement insurance, or depreciation, are \$1 300 000 and the operating net is sufficient to pay taxes and 7 per cent on the investment. Table LVIII shows the income account according to the standard classification of accounts. Table LIX gives some miscellaneous statistics which serve to indicate the general features of the property from an operating standpoint.

TABLE LVIII — INCOME ACCOUNT — STANDARD CLASSIFICATION

| | | |
|---|---|---|
| Operating revenue | .......... | \$2,000,000 |
| Operating expenses (including replacement insurance) | .......... | 1,300,000 |
| Maintenance of way and structures | \$219,000 | .......... |
| Maintenance of equipment | 220,400 | .......... |
| Power | 236,400 | .......... |
| Conducting transportation | 469,600 | .......... |
| Traffic | 5,200 | .......... |
| General and miscellaneous | 149,400 | .......... |
| Net operating revenues | .......... | 700,000 |
| Fixed charges | .......... | 700,000 |
| Taxes | \$105,000 | .......... |
| Interest at 7 per cent on investment of \$8,500,000 | 595,000 | .......... |

TABLE LIX — MISCELLANEOUS STATISTICS

| | | |
|---|---|---|
| Revenue car miles | .......... | 7,000,000 |
| Revenue car hours | .......... | 750,000 |
| Total passengers | .......... | 54,000,000 |
| Regular fare | 40,000,000 | .......... |
| Transfer | 14,000,000 | .......... |
| Maximum number of cars in service | .......... | 250 |
| Miles of track | .......... | 150 |
| Miles of line | .......... | 75 |

To determine what the adoption of the proposal to eliminate the second fare charge on a portion of the line would cost the company, the revenues and expenses of the part of the line under discussion will be investigated and an income account drawn up representing

[1] Operating revenues other than those from the transportation of passengers are excluded. In any case where they are sufficient in amount to affect results, there are two methods by which they may be taken into account. The first method consists in reducing all expenditures by the percentage that the revenues other than those from passenger transportation are of the total revenue. The second method, which is more accurate, consists in setting up a separate income account for each type of service (freight, express, etc.), and apportioning the various items of expense between the several services on the basis of the functional units involved.

this part of the business. The preparation of this income account will follow generally the principles discussed in Chapter VII in which expenditures are classified in accordance with the functional units to which they are most closely related. There will be available for this purpose in the current records of the company certain of the necessary units. Other units, however, must be separately ascertained, and their derivation will be later discussed.

Car miles and car hours within the central zone and for the extension in question can be determined easily and accurately from schedules in effect by noting the number of trips and the scheduled rate of speed of each, or they may be taken directly from the records if such are regularly compiled for statistical and accounting purposes. The miles of track in use and the cars necessary to furnish the scheduled service are also easily determined. The number of cars necessary to furnish service to the end of the line is greater than that which would be required if all cars were turned back at the four mile point. Similarly the number of cars could be still further reduced if the service were furnished for three miles only. The number of passengers carried and the amount of revenue collected at present in both the first and second fare zones are readily determined from the records of the company.

The passenger miles on the system and the various lines are obtained as indicated in Chapter XI, "Application of Traffic Data," and amount to 160 000 000 and 300 000 for the system and the mile of line, respectively. The income account arranged to conform to the units of apportionment is shown in Table LX.

Column one of Table LX gives the functional income account items and is similar in form to the concluding table of Chapter VII, "Units of Comparison." In the second column of Table LX is shown the number of each of the functional units related to the operation of the system. Column three gives the annual cost per unit. In column four have been entered the number of units of each kind which are a result of the operation of the mile of line which it is proposed to take from the second fare zone and place within the first fare zone.

As has been pointed out, the units such as car miles, car hours, miles of track and number of passengers are known, or may be easily determined, and the unit costs relating to these units can be entered directly in the table. The determination of the percentages to be used in connection with the remaining units will require some special study. The expenses which vary with the number of cars handled are chiefly those which relate to the cleaning and housing of cars, and to the switching of cars from place to place in preparation for their being taken out on the line by the regular crew. It is obvious that a car requires no more handling if it makes 150 miles between the time it leaves the car house and returns, than if it makes but 15 miles. There are about 290 000 car handlings per year on the system and of these

TABLE LX — INCOME ACCOUNT — FUNCTIONAL CLASSIFICATION

| ITEM | Income account covering the operation of all lines of company | Number of each of functional units | Annual cost per unit | Number functional units apportioned to mile of line | Annual cost of operating mile of line | Result of proposed change in fare limits |
|---|---|---|---|---|---|---|
| | | | (Cents) | | | |
| Operating revenue | $2,000,000 | 40,000,000 | 5.0 | 400,000 | $20,000 | $2,000 |
| Operating expenses (including replacement insurance) | 1,300,000 | ... | ... | ... | 15,976 | 16,542 |
| Variable operating cost varying with | 909,000 | ... | ... | ... | 10,955 | 11,438 |
| Car miles | 254,600 | 7,000,000 | 3.64 | 93,100 | 3,389 | 3,560 |
| Car hours | 7,200 | 750,000 | 0.96 | 8,700 | 84 | 89 |
| Number of passengers | 65,400 | ... | ... | ... | 570 | 600 |
| Passenger (80%) | 52,320 | 54,000,000 | 0.10 | 540,000 | 540 | 540 |
| Passenger mile (20%) | 13,080 | 160,000,000 | 0.01 | 300,000 | 30 | 60 |
| Cars handled | 51,000 | 290,000 | 17.58 | 2,800 | 492 | 492 |
| Platform labor | 369,000 | ... | ... | ... | 4,208 | 4,381 |
| Car hours (90%) | 332,100 | 750,000 | 44.28 | 8,700 | 3,852 | 4,025 |
| Layover and guarantee (number of runs) (10%) | 36,900 | 145,000 | 25.45 | 1,400 | 356 | 356 |
| Power | 161,800 | ... | ... | ... | 2,212 | 2,316 |
| Car miles (85%) | 137,530 | 7,000,000 | 1.96 | 93,100 | 1,825 | 1,916 |
| Standby costs (15%) | 24,270 | ... | 17.5% | of total | 387 | 400 |
| | | | (Dollars) | | | |
| Fixed operating cost based on | 391,000 | ... | ... | ... | 5,021 | 5,104 |
| Miles of track | 176,400 | 150 | 1,176 00 | 2 | 2,352 | 2,352 |
| Number of cars owned [12] | 58,200 | 250 | 232 80 | 3 | 698 | 733 |
| Power capacity | 38,200 | 250 | 152 80 | 3 | 458 | 481 |
| General overhead and administrative expense | 118,200 | ... | ... | ... | 1,513 | 1,538 |
| Net operating revenues | 700,000 | ... | ... | ... | 4,024 | 14,542 |
| Fixed charges (taxes and return on investment) based on | 700,000 | ... | ... | ... | 8,976 | 9,135 |
| Miles of track | 390,600 | 150 | 2,604 00 | 2 | 5,208 | 5,208 |
| Number of cars owned * | 137,600 | 250 | 550 40 | 3 | 1,651 | 1,733 |
| Investment in power equipment | 103,000 | ... | 412 00 | 3 cars | 1,236 | 1,298 |
| General and administrative equipment (10.9%) | 68,800 | ... | ... | ... | 881 | 896 |
| Deficit | ... | ... | ... | ... | 4,952 | 23,677 |

* The cost of an additional 25 cars, reserve equipment, is spread over the 250 cars in active service.

23 200 are necessary for the operation of the 5-mile line. The handlings properly chargeable to the extension under examination are determined by the relation which exists between car miles and car handlings for the runs over this mile of track, and amount to 2 800 per year.

The apportionment of the cost of platform labor, has been more fully discussed in Chapter VII. This item of expenditure tends to vary with car hours, the only departure from this unit being in cases where conductors and motormen receive compensation for a certain amount of non-running time or in cases where a guaranteed minimum wage serves to increase the hourly rate of pay on short hour runs. In the present instance, it was found that 90 per cent of the expenditure for platform labor varied with the car hours and that 10 per cent of the amount depended upon the number of runs. The total number of runs on the system, counting as one run any period of continuous service, is 145 000 per year, of which number 1 400 runs per year are chargeable to the particular mile of line being examined.

The items which are classified as Power Expenses include both stand-by costs and expenditures for labor and fuel which tend to vary with the consumption of energy, the principal measure of which may be assumed to be car miles. In cases where the weight of cars and number of stops vary greatly and where curves and other conditions are such as to affect the consumption of power as between different cars and different lines, some modification of the car mile basis should be made. In the present case, it is assumed that the cars operating over the various lines do not differ greatly in the consumption of current per mile and consequently that part of the power costs varying with energy consumption will be apportioned on a car mile basis. The power costs include also, however, stand-by costs It will cost as much to prepare to generate 1 000 kw. for two hours as it will to make the same preparation when this load is to be carried for ten hours. Where the extent of the peak demand on power plant varies materially on different parts of the system, the car mile basis as suggested above must be adjusted for use as a basis of apportionment. In the present case it was found that the stand-by costs at different times of the day amounted to 15 per cent of the total power costs. On the mile of track the operation of which is here being examined, the stand-by costs are 17.5 per cent, due to greater concentration of service.

It will be noted also that power expenditures are included in fixed operating expenses under the heading Power Capacity. These consist in large part of maintenance and replacement insurance items. In order to determine the part of the expenses which are a function of power capacity properly allocated to any line, it is necessary to ascertain the proportion of the output which is being taken by the particular line during the time of the maximum power load. In the present problem the maximum number of cars in service at the time of

greatest load on the power plant is 250, of which number three are serving the particular mile of line under consideration.

Under both operating expenses and fixed charges there are shown certain items which may be classed as General Overhead and Administrative Expense. The best practice is to make the apportionment of these expenses on the same basis as the total of the apportionments of the individual items to which they are related. In the present problem the general overhead expenses relating to operating expenses are prorated as an overhead charge to the fixed operating expense group and the general expenses relating to fixed charges and consisting of taxes and return on investment are apportioned on the basis of the apportionment of all other fixed charges.

The items in columns four and five of Table LX are the number of units and the amounts properly chargeable to the particular mile of line, items in column five being the products of the corresponding items in columns three and four.

The net income of the mile of track under consideration as disclosed in column five indicates that under existing conditions there exists an annual deficit of $4 952 in the operation of the added mile for an added fare.

Column six of Table LX discloses the result of the proposed change in fare limits. The operating expenses here apportioned differ somewhat from column five, and reflect proposed rather than existing conditions of operation. These differences arise from the following changes brought about by the extension of the fare limit.

(1) Ninety per cent of the fares now collected in the three and four-mile zone are found to be second fares, the passengers riding into or through the first or central fare zone. All of the added revenue from these fares will be lost.

(2) Some of the passengers now riding only in the central fare zone will continue their rides, due to change in residence or other causes, into the added miles. This will serve to increase the cost if operation due to the increased ride for a single fare. Some additions may also be expected in the service, due to the minimum headway requirements within the single fare zone.

(3) A part of the passengers now riding to and from the four and five-mile zone will walk to the four-mile point in order to have the benefit of the single fare. This will reduce the number of passengers contributing added fares in the last mile without correspondingly reducing costs since the headway, rather than the number of passengers, governs the schedule of operation. These tendencies will result in a longer average ride and in a decreased fare per mile. It is not probable that the proposed change in fare limits will increase the total rides on the system to any appreciable extent.

As the costs reflecting these changed conditions are not material in the present problem, the details of the computation by which the amounts are arrived at need not be elaborated. The forecast of such

changes requires a thorough knowledge of local conditions and their consideration is one of the most serious difficulties encountered in attempting to analyze the influence on cost of fare extensions. Column six shows that the elimination of the extra fare will increase the deficit by $18 725, making a total deficit per mile of track in question of $23 677 during a year's operation.

This deficit is due to a decrease in the revenue from the three and four-mile zone from $20 000 to $2 000. There is a further decrease in revenue formerly collected in the four and five-mile zone of $1 250. This decrease is not taken into account in the estimates of the cost of the proposed extension in column six. There is a deficit in cost of operation alone of $21 677. The amount of the deficit is approximately 3.5 per cent of the investment in the whole of the ten miles of track in the line under consideration, and it is therefore evident that the proposed change in fare limits would result in seriously reducing the return upon the investment in this part of the property. Any proposal to consider extensions upon other lines will further seriously decrease the returns earned by the system as a whole.

II. The second typical problem considered involves the extension of an existing line by construction. It will be assumed that one of the lines of the system which has been under discussion in the treatment of the preceding problem is three miles in length and ends at the city limits. Through annexation of suburban territory, it is proposed to move the city limits out one mile, and it is suggested that the railway construct a mile of line across this territory. It is also proposed by those interested in the development of the suburban real estate thus to be made marketable, that a single fare be the charge for a ride over any part of the original line and the extension.

It is necessary to construct two miles of track for this extension and due to increased cost of labor and material, legal expense, and easements, the cost of constructing the two additional miles of track is $100 000. In addition there is involved capital expenditures for the construction of transmission and distribution systems. It will be necessary to alter schedules as the length of the line is increased and some additions will necessarily be made to rolling stock and power plant equipment. Such investment will be reflected in increased interest charges, increased taxes and increased depreciation. In addition to these fixed charges the cost of operation will be increased depending upon the extent to which service is rendered on the newly constructed lines. These costs can best be determined, as in the former problem, by the application of unit costs to quantities; as for instance, by multiplying the cost per car mile by the number of additional car miles; the cost of maintenance per mile of track by the additional miles of track and by treating in a similar way every item of expenditure on the basis of the unit of operation with which it naturally varies.

As in the previous problem, the first step in the analysis is the setting up of a functional income account, Table LXI, corresponding in form to Table LX.

An examination of the schedules which it will be necessary to adopt in order to operate over the extension will permit the determination of the extent by which car miles, car hours, cars handled and number of cars owned must be increased. It will also be possible to determine the amount by which the installation of power equipment must be increased to carry the additional peak load. The items of platform labor and power output have been discussed in connection with the previous problem and the factors there pointed out should be given consideration in determining the number of units to be used in this problem.

There will result also from the proposed extension some rides tributary to this mile of line. The amount of revenue which will accrue from this source will, however, be practically negligible. A study of the short rides near the end of similar lines will give a basis for estimating the number of rides and passenger units that may be expected to occur on the line in question. An annual revenue of $1 000 is here assumed as that which may be expected to represent additional riding created by the extension.

The only other change in traffic characteristics that may be expected to follow the proposed extension of line, is an increase in length of ride on the line to be extended. This will come about, due to the moving of places of residence to a greater distance from the center of the city by those now regularly patrons of this line or by those now using some other line. In neither case will there be a greater number of rides, but the average length of ride will be increased. This will result in the necessity of additional service as measured in units such as car miles and will also increase that part of the cost shown as varying with the number of passengers, when the length of ride is not a variable factor, but which varies rather with the number of passenger miles.

The overhead expenses will be increased in proportion to the increases in the accounts to which they are related.

Column four of Table LXI shows the number of units of operation on the system following the proposed extension and column five shows the change resulting from increasing the various items of expenditure and the revenue as previously discussed. The result of this extension is thus determined to be a decrease of $17 529 in the amount available for return upon investment. The investment having been increased 1.57 per cent, the rate of return is decreased from 7 per cent to 6.67 per cent. When it is considered that the application of this policy of extending lines would, if applied to 20 of the 23 other lines of the company, completely wipe out the return upon invested capital, the serious character of a program of line extension is evident.

TABLE LXI — INCOME ACCOUNT — FUNCTIONAL CLASSIFICATION

| ITEM | Income account covering the operation of all lines of the company | Number of each of the functional units before extension | Annual cost per unit | Number of each of the functional units after extension | Income account covering operation of all lines after extension |
|---|---|---|---|---|---|
| | | | (*Cents*) | | |
| Operating revenue | $2,000,000 | 40,000,000 | 5.00 | 40,040,000 | $2,002,000 |
| Operating expenses (including replacement insurance) | 1,300,000 | ........ | ........ | ........ | 1,319,529 |
| Variable operating cost varying with | 909,000 | ........ | ........ | ........ | 923,508 |
| Car miles | 254,600 | 7,000,000 | 3.64 | 7,090,000 | 258,076 |
| Car hours | 7,200 | 750,000 | 0.96 | 758,500 | 7,281 |
| Number of passengers | 65,400 | ........ | ........ | ........ | 70,072 |
| Per passenger (80%) | 52,320 | 54,000,000 | 0.10 | 54,040,000 | 54,040 |
| Passenger mile (20%) | 13,080 | 160,000,000 | 0.01 | 160,320,000 | 16,032 |
| Cars handled | 51,000 | 290,000 | 17.58 | 292,900 | 51,492 |
| Platform labor | 369,000 | ........ | ........ | ........ | 373,100 |
| Car hours 90% | 332,100 | 750,000 | 44.28 | 758,500 | 335,816 |
| Layover and guarantee (number of runs) (10%) | 36,900 | 145,000 | 25.45 | 146,500 | 37,284 |
| Power | 161,800 | ........ | ........ | ........ | 163,487 |
| Car miles | 137,530 | 7,000,000 | 1.96 | 7,090,000 | 138,964 |
| Standby costs | 24,270 | ........ | 15% of | total output | 24,523 |
| | | | (*Dollars*) | | |
| Fixed operating cost based on | 391,000 | ........ | ........ | ........ | 396,021 |
| Miles of track | 176,400 | 150 | 1,176 00 | 152 | 178,752 |
| Number of cars owned * | 58,200 | 250 | 232 80 | 253 | 58,898 |
| Power capacity | 38,200 | 250 | 152 80 | 253 | 38,658 |
| General overhead and administrative expense (43%) | 118,200 | ........ | ........ | ........ | 119,713 |
| Net operating revenues | 700,000 | ........ | ........ | ........ | 682,471 |
| Fixed charges (taxes and return on investment) based on | 700,000 | ........ | ........ | ........ | 710,960 |
| Miles of track | 390,600 | 150 | 2,604 00 | 152 | 397,600 |
| Number of cars owned * | 137,600 | 250 | 550 40 | 253 | 139,251 |
| Investment in power equipment | 103,000 | 250 | 412 00 | 253 | 104,236 |
| General and administrative equipment (10.9%) | 68,800 | ........ | ........ | ........ | 69,873 |
| Deficit | ........ | ........ | ........ | ........ | 28,489 |

* The cost of an additional 25 cars, reserve equipment, is spread over the 250 cars in active service.

The two foregoing typical problems have been explained in some detail owing to the complexity of the calculations involved in determining cost of service. They suggest the solution of the general problem.

> What is the average distance to which the company can afford to carry a passenger or haul a car for a single fare?

This is the general problem given consideration in the car mile formula of Mr. Ford, the car haul formula of Mr. Bradlee and the "load factor" formula as described by Mr. Duffy. This general solution may be outlined basing the computations upon the revenues and expenses previously used by way of illustration.

As shown in Fig. 34, (Page 225) there is a fairly close relation between length of line and length of ride so that the conclusions reached by the two methods of analysis may be compared.

The general form of income account may be simplified for purposes of computing these distances, as shown in Table LXII.[1]

TABLE LXII — CONDENSED INCOME ACCOUNT

| ITEM | Amount | Number of units | Cost per unit |
|---|---|---|---|
| Operating revenue (total) | $2,000,000 | ........ | ........ |
| Cost of service (total) | 2,000,000 | ........ | ........ |
| (*a*) Costs varying with car hour | 376,200 | 750,000 | 50.16 cents |
| (*b*) Costs varying with car mile | 305,600 | 7,000,000 | 4.37 cents |
| (*c*) Costs varying with mile of single track | 176,400 | 150 | $1,176 |
| (*d*) Costs varying with number of passengers | 65,400 | 40,000,000 | .16 cents |
| (*e*) Costs of electrical energy (car mile) | 161,800 | 7,000,000 | 2.31 cents |
| (*f*) Administrative and overhead expense burden | 319,600 | per cent items (*a*) to (*e*) inclusive. | 29.4% |
| (*g*) Return upon investment | 595,000 | ........ | ........ |

Table LXII is obtained from Table LXI as follows. The expenses varying with car handlings are combined with those varying with the car mile under the heading "car mile", and expenditures for platform labor are included with the car hour costs under the heading "car hour." These changes are in line with the facts when the operation of a system as a whole is considered. The remaining fixed operating costs are combined and taxes included in the total shown under the heading General Administrative and Overhead Expense Burden.

[1] Table XXV, Chapter VII, "Units of Comparison," shows the functional income account in its general form. Certain problems in the allocation of costs of parts of the service a traction company renders, may be solved by the use of a classification somewhat more simple. Other problems, however, such as the ones previously treated in this chapter and those referred to in succeeding chapters, such as the determination of cost of service at different periods of the day, discussed in Chapter XVI, require the use of the general form.

In order to determine the reasonable average length of ride the costs must next be classified as *movement* and *terminal.* These terms have long been used in the analysis of costs of transportation on steam roads, and while the analogy is not perfect, they will serve the purpose of the present computation. Movement expenses may be defined as those which increase directly as the length of ride, while terminal expenses are those properly chargeable to each passenger independent of the length of his journey.

In the present case, the expenditures varying with car hours, car miles, and the production of electrical energy are grouped together and amount to $843 600. These may be termed the *traffic* group of expenses. Expenses varying with the mile of track amount to $176 400, and those related to the number of passengers to $65 400. The general expense of $319 600 when prorated over these three groups of expenses makes them respectively $1 092 000, $228 300, and $84 700. A part of the first group of expenses or *traffic* costs varies with the extent of the service rendered when measured in passenger miles and this part may be called the *use* portion. The balance of this group is in the nature of *demand* cost arising from expenses incurred by the company in maintaining its plant in readiness to serve. To determine the use and demand portions of this group of expenses, use is made of the ratio of the facilities furnished to facilities used, or the relation of space miles to passenger miles. In the present case, the capacity of the average car is 40 passengers, and the car miles per year 7 000 000. If all the facilities furnished had been used, the passenger miles would have been 280 000 000. The 40 000 000 passengers rode during the year 162 000 000 miles in 54 000 000 trips, the average use of facilities being 58 per cent. Applying this percentage to the item of $1 092 000 above, the *movement* portion is determined to be $633 360. To this should be added the amount of $84 700, giving a total movement expense of $718 060. The *terminal* expenses are determined by combining the remainder of the traffic group of expenses with those varying with the mile of track and the amount necessary to render a reasonable return upon the investment. In the present case, the total is $1 281 940.

The movement expense of $718 060 amounts to 0.443 cents per passenger mile and the terminal expense of $1 281 940 amounts to 3.205 cents per passenger. A fare of five cents will pay, then, the terminal cost of 3.205 cents and leave a remainder of 1.795 cents which will pay for a ride four miles in length. Taking into consideration the fact that 35 per cent of the passengers make two rides for one fare by the use of transfers, the length of ride becomes three miles. If an 8 per cent return is calculated on the investment, the permissible length of ride is further reduced to 2.65 miles.

The above conclusion is obtained by using the average length of passenger haul. A solution of the problem based on car haul is equally satisfactory and somewhat more easily obtained, due to the

fact that car mileage is regularly and accurately recorded, while statistics as to passenger miles are obtained with greater difficulty.

Considering now the problem of the profitable length of the half-round trip of a car, the expenses will be combined into two groups. The first consists of the car mile, car hour, and power costs, and amounts to $1 092 000, or 15.6 cents per car mile. The other expenses, amounting to $908 000, are independent of the length of the trips and as was done in the preceding paragraphs, will be considered as terminal or per trip expense. The schedule indicates that there are 1 166 700 round trips made each year or 2 333 400 half-round trips. The fixed or terminal cost per half-round trip is then 38.9 cents. The average revenue per half-round trip is 85.7 cents, which will pay the fixed costs of 38.9 cents and leave available for mileage expenses 46.8 cents. This will pay for a run of about three miles.

It is of interest to note in connection with the two preceding computations, the effect on profitable length of car haul and passenger ride, of changes in load factor. In estimating the effect of changes in load factor which has been defined as the ratio of facilities used to facilities furnished, no change in schedules is assumed, the entire change in load factor arising from increases and decreases in the average number of passengers per car, or in traffic density. As is pointed out in Chapter XVI, additional riding at the time of the peak load frequently results in expenses in excess of the fares paid, while riding at other periods of the day when a part of the plant would otherwise be idle would be profitable to the utility. Assuming then that no changes in schedules are made, it is apparent that as the load factor increases, the terminal cost per passenger will decrease, while the movement cost remains unchanged. This results in a larger portion of the fare being available for movement costs, and in a longer profitable ride. The range is from zero miles when the load factor is 42.1 per cent, to six miles when the load is 70.0 per cent.

The effect of load factor on the profitableness of various lengths of car trips is also of interest. The traffic group of expenses amounting to $1 092 000 will remain constant for such changes in loading as are here considered as occasioning variations in load factor, and the car mile cost will be as shown above, 15.6 cents. Of the remaining expenses, those related to the mile of track and the return on investment will remain constant, while the passenger costs will vary from $43 900 at a 30 per cent load factor, to $102 700 at a 70 per cent load factor. The terminal cost per half-round trip varies then from 37.2 cents to 39.8 cents for load factors of 30 and 70 per cent respectively. The earnings per half-round trip likewise vary from 44.5 cents to $1.04. The length of half-round trip which for a load factor of 58 per cent was found to be three miles, can be increased to 4.1 miles if the load factor can be raised to 70 per cent.

The effect of changes in load factor on profitable length of car haul and passenger ride is shown graphically in Fig. 35.[1]

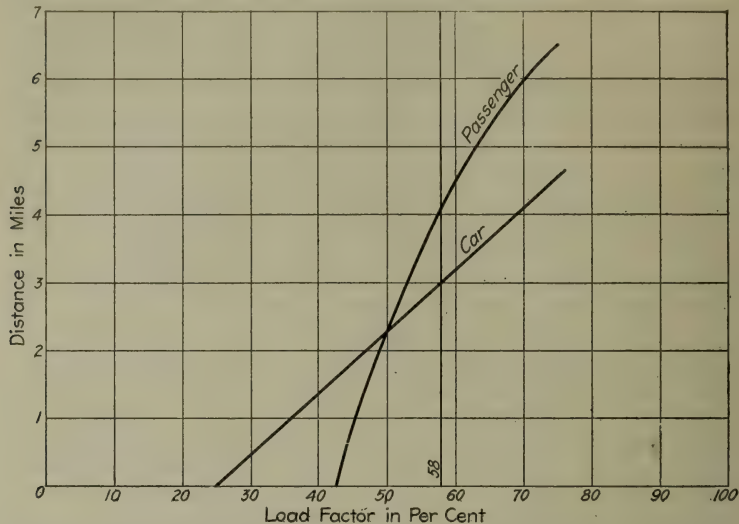



FIG. 35.— RELATION BETWEEN LOAD FACTOR AND LENGTH OF HAUL.

---

[1] The general equations from which the values on these two curves are derived are shown below:

**R**=Profitable length of passenger ride,—miles
**S**=Profitable length of half round trip,—miles

| | | |
|---|---|---|
| *P*=Number of passengers | *f*=Rate of fare | In dollars |
| *P M*=Passenger miles | *d*=revenue per trip | |
| *C M*=Car miles | *t*=Traffic costs | |
| *H T*=Half round trips | *t m*=Traffic mile costs | |
| *L F*=Load factor | *p*=Passenger costs | |
| | *r*=Return on investment | |

$$\mathbf{R} = \frac{f - \dfrac{t(1-LF.)+tm+r}{P}}{\dfrac{t(LF.)+\mathrm{p}}{PM}}$$

which in the present case reduces to

$\mathbf{R} = 14.9 - \dfrac{434}{\mathbf{P}}$, *where* **P** = *number of passengers per year in millions.*

$$\mathbf{S} = \frac{d - \dfrac{tm+r+p}{HT}}{\dfrac{t}{CM}}$$

which, in the present case reduces to

$\mathbf{S} = \dfrac{2.05\,P - 35.3}{15.6}$, *where* **P** = *number of passengers per year in millions*

# CHAPTER XV

## THE PAYING HAUL — APPLICATION TO THE ZONE SYSTEM OF FARES

The American System of Flat Rates for Urban Passenger Transportation Service,—— Reasons for Adoption,—— Advantages and Disadvantages,—— Recent Progress Away from Flat Rates, —— Factors Opposed to and Favorable to Change,—— The Zone System of Fares,—— Advantages and Disadvantages,—— The Zone System of Fares, Congestion and Riding Habit,—— Cost Factors Involved in Construction of Zone System of Fares,—— Necessary Information,—— Apportionment of Cost,—— Typical Problem Analyzed.

In the previous chapter, the paying haul was discussed in its relation to the cost of extending fare limits and lines. Of equal importance in many cases is the relation of the paying haul to the rates of fare. On a small urban system, the advantages of a single rate of fare for all trips may outweigh the advantages of a zone system. On an interurban system the reverse is true. As the small urban system expands, there comes a time when serious consideration must be given to the question of a system of fares which will provide additional revenue to meet the costs of additional service. While generally adopted in European cities, the zone system of fares, which tends to cause each patron to contribute to the revenues of a company in proportion to the extent to which he occasions costs, has not been generally considered in this country.[1]

Discrimination between individuals of a class or between classes of patrons is specifically provided against in utility laws. Carriers are forbidden to charge less for a long haul than a shorter one where the greater includes the less, and there is frequently a clause to the effect that this prohibition shall not be construed as authorizing the carrier to charge as great an amount for a shorter as for a longer distance.[2]

---

[1] The Milwaukee Electric Railway & Light Company is a notable exception. For a complete discussion of the situation in that city together with the methods employed in determining the location of zones and the practice in fare collection see "A Zone System of Fares in Practice" by R. B. Stearns, Vice-President and Assistant General Manager. T. M. E. R. & L. Co., 1914 *Proceedings American Electric Railway Association*, page 213,

[2] The wording of the Act to regulate commerce covering this point is as follows, and has been incorporated practically verbatim into the public utilities acts of a number of states:
"Sec. 4. (*As amended June 18, 1910.*) That it shall be unlawful for any common carrier subject to the provisions of this Act to charge or receive any greater compensation in the aggregate for the transportation of passengers, or of like kind of property, for a shorter than for a longer distance over the same line or route in the same direction, the shorter being included within the longer distance, or to charge any greater compensation as a through route than the aggregate of the intermediate rates subject to the provisions of this Act: but this shall not be construed as authorizing any common carrier within the terms of this Act to charge or receive as great compensation for a shorter as for a longer distance: *Provided, however*, That upon application to the Interstate Commerce Commission such common carrier may in special cases, after investigation, be authorized by the Commission to charge less for longer than for shorter distances for the transportation of passengers or property; and the Commission may from time to time prescribe the extent to which such designated common carrier may be relieved from the operation of this section. * * *"

The urban electric railways of the United States make the same charge for a trip of one block as for a trip of five miles.[1] This ob-

[1] Memorandum by Frank R. Ford, to the Committee on Determining the Proper Basis for Rates and Fares of the American Electric Railway Association, 1911 Proc. p. 280.

**FACTORS WHICH GOVERN TRANSPORTATION RATES**

| *Basis* | *Unit* | *Example* |
|---|---|---|
| 1. Distance | (a) Passenger mile | Steam railroad, interurban electric railway, etc. |
| | (b) Passenger zone | European street railway. |
| | (c) Vehicle mile | Taxicab. |
| 2. Wholesaling | (a) Round trip | Steam railroad, electric railway ferry, etc. |
| | (b) 50-trip | " |
| | (c) Strip tickets | " |
| | (d) Commutation | " |
| 3. Age or size of passengers. | (a) Half fare | " |
| | (b) Free (infants in arms) | " |
| 4. Occupation of passengers. | (a) School ticket | " |
| | (b) Workmen's ticket | " |
| 5. Class of equipment or accommodation. | (a) 1st class, 2nd class, 3rd class | European railroad, steamship. |
| | (b) Parlor car, sleeping car, etc. | Steam railroad, interurban railway, etc. |
| | (c) Double street car fare | Auto bus. |
| 6. Elapsed time | (a) Passenger hour | Cab. |
| | (b) Chartered car hour | Electric railway. |
| 7. Time of day | (a) Double fare for owl service. | Street railway |
| | (b) Reduced fare for rush-hour service | " " |
| 8. Day of week | (a) Reduced rate for holidays, excursions, etc | Steam railroads, steamboats, etc. |
| | (b) Double fare for Saturdays Sundays and holidays | Street railway (Coney Island fare). |
| 9. Speed | (a) Limited train (or ship) fare. | Steam railroad, steamship. |
| | (b) Passenger pool differential. | " " " |
| 10. Discontinuity of passage. | (a) One cent transfer | Street railway. |
| | (b) Three cent exchange | " " |
| 11. Direction of passage. | (a) Reduced rate in light direction | Street railway (Coney Island fare). |
| 12. Weight | (a) Ton mile for freight | Steam railroad. |
| 13. Space | (a) Cubic foot for freight | Steamship. |
| 14. Readiness to serve | (a) Initial charge | Taxicab. |
| 15. Expense at service terminals. | (a) Present National boundary, weight | Postal service. |
| | (b) Message zone | Telephone, telegraph. |
| | (c) Passenger within present and future city limits | Street railway. |
| 16. Free | (a) Transfers | Street railway. |
| | (b) Dead heads | Steam railroad, street railway, etc. |

"It will be seen that a large number of factors govern the matter of transportation rates, but practically all of them are disregarded in the standard five-cent flat rate adopted in most American cities. The simple nature of this standard appealed to the railway managers in the early days of the industry when in many cases for the short rides involved, the nickel fare apparently represented more than a reasonable return, especially when the cost of maintenance and renewals of the property was overlooked.

"If the rate of street railway fares were placed on a measured basis and such measure took into account a number of different factors as above, the rate of fare would become more of the complex problem which it has assumed in the electric lighting industry and would be subject to reasonable analysis for specific classes of service rendered."

viously is a discrimination against the patron whose journey is less than the profitable length of haul, and in favor of the one riding a greater distance. An examination of the regulatory legislation would indicate that the uniform or flat rate is contrary to its intent and certain specific provisions of these laws confirm this impression. However, the flat rate is of long standing and is used by the patron without consciousness of its disadvantages. Any suggestion that it be superseded must bear the burden of proof as to the superiority of the substitute scheme. Other forms of rates are in extensive use elsewhere and might be proposed to take the place of the flat rate, but before examining any such, it will be well to look at the origin of the flat rate or American plan of fares.

The American system of urban electric railway rates is essentially a flat rate system, the nickel being the customary charge. This assumes that there is at any time a sufficient number of short distance riders to pay for the losses incurred in carrying the long distance riders. In the early days of the industry, when lines were short, there was no great difference in length between the long and short rides. There was usually but one employe on each car and since the possible discrimination was not great the convenience of making all fares the same was, therefore, a controlling factor. Some lines charged ten cents and a few rates between ten and five cents, but here, too, convenience operated to bring about a general five-cent fare. At first this was a purely experimental rate but the operators quickly learned that adjustments downward are a matter of much greater ease than those involving an increase in fare. However, the origin of this system of rates is best understood in the light of conditions in the days of the short ride in light weight horse cars upon an inexpensive track. During that trial period, as has been already pointed out in Chapter IV, the purchasing power of the nickel was very much greater than at present, the service rendered the public was far inferior in every way, the length of ride was short, and the fare was not attenuated by the free transfer. In consequence thereof, it was hoped that the five-cent fare would be ample. With the consolidations of the nineties, and the subsequent extensions of lines into sparsely settled districts, making possible the growth of cities, the length of the average ride has continually increased. Moreover, as is well known, the purchasing power of money has continually decreased. Under such conditions, the inadequacy of the nickel fare has become clearly apparent.

That the flat rate of fare has its advantages is undeniable. Its simplicity of computation and general convenience both to the patron and the fare collector are readily seen. Moreover, it has the sanction of custom. "The benefits of the uniform low fare undoubtedly have been great from the sociological point of view, and still greater in the development of real estate and taxable property; but all at the expense of the investors in street railways, who would have been

well advised had they long since adopted the more logical European system[1] of fare rates proportioned to journey lengths."[2]

The flat rate of fare has also its disadvantages, the chief one being that it makes one who rides one mile contribute toward the ride of another who journeys several miles — in other words, there is no connection between the service rendered and the charge. Moreover, the flat rate of fare does not permit the development of competing forms of transportation on a sound economic basis.[3]

In recent years, considerable progress has been made away from the flat rate idea which has characterized much of the service rendered in America in the past. In the operation of hotels, the flat rate became known as the American plan, but is now falling into disuse. In the case of theatres, the reserved seat charge and later the graduated scale of prices have supplanted the flat rate idea of general admission. The introduction of limited service and the sleeping car has brought about a similar differentiation in steam railroad rates with the result that an extra charge is now made for additional speed or comfort. Among others, public utilities have made considerable progress away from the flat rate idea. Thus, the water, gas, and electric light and power companies have almost universally abandoned the flat rate. In its place, there was adopted first a uniform rate, under which the charge varied directly with the quantity sold. Later there has come into use the graduated or "demand" basis of rates which calls for a decreased rate per unit as the load factor increases. The least progress along these lines has been made by urban electric railways, which still use practically without exception, the flat rate of fare. This lack of progress by electric railways has been due to a number of factors.

---

[1] In 1913, the American Electric Railway Association collected a large amount of material concerning the rates of fare in effect on electric lines in European cities and the methods of collection and accounting in use. This material was translated and abstracted by a committee of the Milwaukee Company Section No. 1, A. E. R. A. Certain of the conclusions reached by this committee are reported by Mr. R. B. Stearns in "A Zone System of Fares in Practice," 1914 *Proceedings American Electric Railway Association*, page 213. Of these, the following are pertinent in this connection:

"(1) The zone system is used in all of the sixteen European cities from which reports were received.

(2) The length of ride and rates of fare are varied, but considering the purchasing value of money, the rates are generally higher than the fares in this country, and higher than those obtaining in Milwaukee.

(3) Small increments in the fares for additional distance traveled are provided throughout the congested or central districts as well as the outlying districts.

(4) The rates provide much higher fares for the distance equivalent to the boundary of the central zone than exist in Milwaukee, and probably other American cities. The same is noted for the total fare to other zones.

(5) A marked similarity in the methods of collecting and recording fares in all of the cities is noted. In every instance receipts are given for the fares when collected and these receipts are subject to check by inspectors who board cars at unexpected intervals.

(6) The issue of transfers generally carries extra charge and free transfers are exceptional.

(7) Special fares for workmen and special ticket rates are common but limited to restricted hours, usually issued before 7:30 a. m. and good for return before 8 p. m.

"It is certain, however, that valuable lessons can be learned through studying the methods of our careful, painstaking neighbors and the adoption of certain details of the European methods in this country would undoubtedly prove advantageous."

[2] C. S. Sergeant, "Problems Confronting Street Railways," *Electric Railway Journal*, January 1, 1910.

[3] See Chapter XVIII, Cost of Competing Forms of Transportation.

Of greatest importance in this connection, has been the restraining influence of habit. Not only have many people come to believe that they have a kind of vested right in the five-cent fare but there has been considerable agitation for reductions of various sorts. Moreover, since the long distance riders have steadily increased in number and since under a graduated system of fares, many of them would have to pay more than five cents, there has resulted much opinion adverse to any change. Still another factor opposed to change has been the lack of knowledge as to the cost of the service rendered. Many patrons believe that they have been and are paying their equitable share of the cost, while as a matter of fact, the reverse is often true.

A change in the direction of a graduated system of rates on electric railways has first of all sound logic in its favor since according to this scheme of payment for service rendered, each patron pays for the service he himself receives. This is clearly to the advantage of those entitled to lower charges, while it is not unfair to the others to be required to pay their proportionate share of the expense. Because of the constant allegation of discrimination both by individual patrons and by representatives of communities, there has been a considerable growth of sentiment in favor of a scientific and equitable solution of the problem, such as may be obtained through the adoption of a graduated scale of charges. Of interest in this connection is the recent decision of the Railroad Commission of Wisconsin, in re Milwaukee Suburban and Interurban Railway Rates, quoted in part below (13 W. R. C. R. 475):

*Discriminatory features of the five-cent zone.* In selling transportation to persons the adopted standard unit of measurement is the passenger mile — one passenger carried one mile. Although steam lines in general have adhered to this standard the electric interurban systems in many cases have used the so-called five-cent system of rates. This system is merely an extension of the flat five-cent city fare and has no scientific basis for suburban or interurban operation. The resultant inequalities which exist under this system of rates may well be illustrated by measuring the different fares charged by the unit of measurement — the passenger mile. No better examples can be cited than can be found upon the suburban and interurban systems involved in the present proceeding * * *.

*Discriminatory features of overlapping zones.* Directly due to the inequitable nature of the five-cent zone system, as outlined in the * * * discriminations of one-way fares, is the practice of granting overlapping zones, special and round-trip rates to favored points. When overlapping zones are injected into the five-cent zone system we have a rate scheme which places every locality in competition with its neighbors. For instance, it is usually contended that if a company extends the limits of an interurban zone for one-half mile so as to reach a certain locality, and thereby grant a lower fare to this locality to all points through the overlap, it logically follows that the next locality a quarter or a half-mile distant should be granted a similar concession. The result is that this necessity of granting overlaps caused the rate schedules to become even more discriminatory, and carried to its logical conclusion, the entire schedule ultimately must fall to the ground.

In any equitable system of fares for suburban and interurban service the overlapping zone cannot be justified except under very extreme conditions.

*Necessity of uniform distance basis for fares.* In establishing a revised system of interurban and suburban fares, it is fully realized that the present fares will be considerably disturbed in some sections of the territory, but this is not due to the application of any radical or untried theory of rates. It is due principally to the fact that the existing fares * * * do not rest upon any scientific basis, but are based upon unequal zone distances and concessions to favored localities. The results of such a schedule are obvious. Invariably one or more localities are built up at the expense of others. Patrons favorably situated are granted extremely low fares, part of the cost of which has to be borne by those less favorably situated and paying excessive rates. With these facts in mind, a revision is here undertaken with the sole aim of removing as much of the discrimination as possible and placing a schedule of fares in force, upon a uniform rate per passenger mile, which will equalize opportunity for local growth and expansion, insure equitable treatment of individuals and reasonably preserve the amount of traffic upon the various lines.

A system of graduated charges for service rendered by electric railways has been generally known as a zone system of fares. Such a system pre-supposes a certain initial or minimum charge and an additional charge for every additional fixed distance traversed. The charge is composed of two parts — a terminal charge which remains constant for any distance, whether a block or five miles; and a movement charge which varies roughly with the distance.[1] It may be pointed out in this connection that distance is not always a fair criterion and that in addition, there should be considered the density of population in the immediate neighborhood of a line in question, riding habit, and other pertinent factors. Under European conditions, the initial charge may be made somewhat smaller than under American conditions, due to differences in costs and methods of operation.

One of the fundamental advantages of the zone system of fares over a flat rate lies in the possibility of placing extensions of lines on a sound basis.[2] Under a flat rate, the fixed charges and operating costs

---

[1] See discussion in Chapter XIV. Page 226.

[2] The following excerpts from an unpublished address by Mr. R. B. Stearns, Vice-President and Assistant General Manager of The Milwaukee Electric Railway & Light Company, are of interest in this connection:

Few cities with less than 100,000 population reach a condition in city service where this problem (the proper basis for rates and fares) approaches the point of serious consideration. When, however, the density in the so-called central district of larger cities exceeds 10,000 inhabitants per square mile, the problem of properly serving the suburban or second fare passengers presents serious difficulties, and the practice of charging therefor an additional full fare usually meets with much opposition, largely because of a lack of sufficient information on the part of the public as to the cost of service and other factors entering into the question.

The importance of educating the public that the car mile is the largest element of the company's expense, and that long distance riders are the most expensive, and should properly pay proportionately, is more and more apparent. * * *

With the advent of the public utility laws, administered by a commission, and founded upon the theory that a fair return upon the investment is a prerequisite to the maintenance of the integrity of the securities, problems of this nature take on a more scientific phase, and as in the case of Milwaukee, extensive traffic studies have been made by the commission followed by similar studies by the company. * * *

Any system of maintaining a flat rate of fare for both the central and the suburban district, even if the rate of fare is increased, does not admit of adjustment of the fare to the increasing long haul traffic. Such adjustment is had only by having a central district fare with an additional fare for the outlying zone.

of extensions become a burden on the rest of the service and as pointed out in Chapter IV, the expansion of city areas accompanied by extension of lines and increased length of haul may make this burden a serious matter. It is not contended that under a zone system of fares it will be possible to make each extension pay the same rate of return on its cost but it will be possible to approach this and to lessen to a considerable extent the contribution to the cost of this service made under usual conditions by the other patrons.

It is not unusual to urge against the zone system of fares the objection that it discriminates[1] against the patron living but one or two blocks beyond the established fare limits. This difficulty may be obviated by the use of overlapping zones, although this is not free from criticism. When a zone fare of one or two cents is charged, there will result little objection to the collection of so small a fare even if the ride within the zone is short. Particularly in suburban business, the so-called copper zone has this particular advantage over the nickel zone — that there is very much less objection to the payment of an increment of fare for a ride of less than the width of the fare zone.

Difficulty in the collection of fares has been suggested as a disadvantage but experience in Milwaukee has shown that this may be overcome without great difficulty.

Probably the most frequently urged objection to the zone system of fares is that its use produces a high degree of congestion of population. There are in general two lines of reasoning which tend toward this conclusion. The first is that in certain European cities, where the transportation systems are operated on the zone system, there is a high degree of centralization. The inconclusiveness of such reasoning is apparent upon a consideration of the fact that this congestion existed prior to the street railways and was brought about originally by the limitations placed upon city expansion by walls erected for military purposes. It is impossible to make accurate comparisons between European and American cities for many reasons but it is pertinent to point out that while American cities have been free to expand and hence show an average density of population

---

[1] Report of the sub-committee of the 1912 Committee of the American Electric Railway Association on Determining the Proper Basis for Rates and Fares — AERA, December, 1912, page 383:

As to extensions of existing city fare limits sometimes required by municipalities when outlying territory is annexed to cities, or the rate of charge for a second fare to existing outlying districts, the zone system of fares should be applied. The preferable method would be a division of the territory beyond the single fare limits into fare zones, for which a charge for a ride in each zone would be made.

The establishing of a zone system of fares as herein suggested would appear to be in line with sound business principles and good public policy, should aid in the development of outlying territory, warrant the extension of lines, remove the barriers that apparently now exist as between the city and the suburbs, and at the same time, solve the problems involved, in a practicable and satisfactory way both to the public and the railways.

The cost of providing urban and suburban electric railway transportation is largely dependent on and more or less directly proportional to, the distance passengers are carried. Sooner or later an economic limit to this distance must be reached, beyond which passengers can not be carried on rates of fare wholly inadequate for the service performed.

somewhat less than European cities,[1] there is nevertheless great congestion in some American cities. Table LXIII compiled from a report made February 2, 1914, by J. M. McElroy, General Manager of the Tramways Department, City of Manchester (England) is of interest in this connection.

Table LXIII — Population per Square Mile — European and American Cities.

| The Greater City | Population per square mile |
|---|---|
| Berlin | 26 900 |
| Boston | 23 800 |
| Vienna | 22 800 |
| Paris | 21 100 |
| New York | 14 800 |
| Philadelphia | 12 500 |
| Chicago | 11 700 |
| London | 10 400 |
| Manchester | 9 950 |
| Average: 5 zone-fare cities | 18 200 |
| Average: 4 flat-rate cities | 15 700 |

The figures shown in Table LXIII are derived by dividing the population of the "greater city" by its area. This area was not determined on the basis of fare limits nor on the basis of political divisions, but represents Mr. McElroy's judgment as to what constitutes in each case the "greater city."

[1] During the last fifty years, congestion has been lessening in certain European cities. The following table, showing the situation in Paris, is of interest in this connection.

Report, M. L. Dausset — "Influence des nouveaux modes de transport en commun sur les développement et l'extension des grandes cités." XVII Congrès International de Tramways et de Chemins de fer d'intérêt local (1912).

Area, Population and Density of the Different Sections in the Center of Paris (1861–1911)

| Section of City | Area in hectares* | Population per hectare | | | Decrease in 50 years | |
|---|---|---|---|---|---|---|
| | | 1861 | 1896 | 1911 | No. | Per cent |
| Saint-Germain l'Auxerrois | 93.55 | 117 | 91 | 67 | 50 | 42.73 |
| Les Halles | 41.00 | 1,032 | 743 | 696 | 336 | 32.55 |
| Le Palais-Royal | 28.45 | 782 | 480 | 431 | 351 | 44.88 |
| La Place Vendome | 27.00 | 520 | 473 | 423 | 97 | 18.65 |
| Gaillon | 19.20 | 613 | 399 | 315 | 298 | 48.61 |
| Vivienne | 23.30 | 628 | 498 | 419 | 209 | 33.22 |
| Le Mail | 27.00 | 843 | 674 | 582 | 261 | 30.96 |

* hectare — 2.471 acres,

From detailed charts showing the distribution of population within these cities, there has been constructed Table LXIV.

TABLE LXIV.— MAXIMUM DENSITY [1]

| City | Observed | | Population per square mile |
|---|---|---|---|
| | Area (in square miles) | Population | |
| Paris | 0.45 | 86 000 | 191 000 |
| Berlin | 0.56 | 98 000 | 175 000 |
| London | 0.55 | 64 000 | 115 000 |
| Vienna | 0.41 | 54 000 | 131 000 |
| New York | 1.61 | 580 300 | 360 000 |
| Philadelphia | 1.00 | 98 000 | 98 000 |
| Boston | 0.27 | 31 000 | 115 000 |
| Chicago | 0.31 | 32 000 | 103 000 |

From this table, it is evident that even if it were legitimate to base claims of decentralization for flat rates of fare on comparisons of American with European cities, the actual comparison would not be convincing.[2]

The second line of reasoning which purports to indicate that the zone system of fares tends toward congestion is that the incentive to save is such that the poorer classes will be deterred from taking the longer journeys, and will therefore tend to dwell in the neighborhood of their work. For several reasons this argument appears upon examination to be unconvincing. Under the flat rate of fare the charge, being the mean of all charges paid by rich and poor alike under the zone system, will be sufficiently large to furnish a considerable incentive not to ride at all. Experience shows that the greatest congestion arises among those individuals who either walk to their work or who work in their homes. These people can not afford the

[1] European data obtained from following sources: Annuaire Statistique de la Ville de Paris, 1906; London Statistics (London County Council), 1913–1914; Statistisches Yahrbuch der Stadt Berlin, 1908–1911 (1905 data used); Statistisches Yahrbuch der Stadt Wien, 1912 (1910 data used).

American data obtained from following source: 1913 Report of Transit Commissioner, City of Philadelphia, Volume II (1910 data used).

[2] Mr. Lawrence Veiller, a well-known housing expert, wrote in 1905:

> No conception of the existing conditions can be obtained from any general statements. To say that the lower East Side of New York is the most densely populated spot in the habitable globe gives no adequate idea of the real conditions. To say that in one section of the city the density of population is 1,000 to the acre and that the greatest density of population in the most densely populated part of Bombay is but 759 to the acre, in Prague 485 to the acre, in Paris 434, in London 365, in Glasgow 350, in Calcutta 204, gives one no adequate realization of the state of affairs. No more does it, to say that in many city blocks on the East Side there is often a population of from 2,000 to 3,000 persons, a population equal to that of a good-sized village. The only way that one can understand the real conditions is to go down into the streets of these districts and see the thousands of persons thronging them and making them impassable. So congested have become the conditions of some of the quarters of this city, that it is not an exaggeration to say that there are more people living there than the land or the atmosphere can with safety sustain. The limits have not only been reached, but have long been passed.

average fare, but some could and would avail themselves of the lower zone fares to better neighborhoods. While these tendencies may be observed, the general wage level and scale of living in this country are such that car fare is not an important item in the family budget of the majority of street railway patrons. Tables LXV and LXVI are based on data collected by R. C. Chapin [1] and are of interest in this connection.

Table LXVI — Expenditures for Carfare in Relation to Monthly Rental Paid (Manhattan and Brooklyn Combined)

| Annual Expenditure for Car Fare | Monthly rental | | | | | Total number of families | Per cent of families |
|---|---|---|---|---|---|---|---|
| | $10 and under | $10.50–12.50 | $13.00–15.00 | $15.50–17.50 | Over $17.50 | | |
| Under $10 | 6 | 13 | 13 | 4 | 9 | 45 | 27.8 |
| $10 to $20 | 4 | 5 | 9 | 1 | 1 | 20 | 12.3 |
| $20–$30 | ...... | 6 | 9 | 2 | 5 | 22 | 13.6 |
| $30–$40 | 4 | 12 | 24 | 8 | 9 | 57 | 35.2 |
| Over $40 | 5 | 4 | 5 | 3 | 1 | 18 | 11.1 |
| Total number of families | 19 | 40 | 60 | 18 | 25 | 162 | ....... |

Finally, as indicating that the riding habit in American and European cities does not in itself furnish a basis of comparison between the flat rate and zone system of fares, Table LXVII is shown.

Table — Riding Habit in American and European Cities

| City | Annual rides per capita — 1910 (approximately) |
|---|---|
| Greater New York | 330 |
| Chicago | 285 |
| Boston | 280 |
| Philadelphia | 275 |
| London | 245 |
| Glasgow | 270 |
| Manchester | 200 |
| Sheffield | 205 |
| Liverpool | 187 |
| Vienna | 175 |
| Berlin with suburbs | 186 |
| Dresden | 237 |
| Cologne | 212 |
| Leipsic | 204 |

[1] R. C. Chapin — The Standard of Living in New York City — Russel Sage Foundation, 1909.

TABLE LXV — EXPENDITURES FOR GIVEN OBJECTS — AVERAGES AND PERCENTAGES — BY INCOME

(Greater New York.)

| Description | | | Income | Expenditures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Income Group | Number of families | Number of persons average | Total average | Total average | Rent, Per cent of total | Car-fare. Per cent of total | Fuel-light. Per cent of total | Food. Per cent of total | Clothing. Per cent of total | Insurance. Per cent. of total | Health. Per cent of total | Sundries. Per cent of total |
| $400– $499 | 8 | 5.4 | $452 | $463 | 26.8 | 2.6 | 5.6 | 40.8 | 13.0 | 1.2 | 3.1 | 6.9 |
| 500– 599 | 17 | 5.0 | 544 | 547 | 25.9 | 1.8 | 5.9 | 44.4 | 12.4 | 1.3 | 1.9 | 6.4 |
| 600– 699 | 72 | 4.9 | 650 | 651 | 23.6 | 1.7 | 5.8 | 44.6 | 12.9 | 2.0 | 2.1 | 7.3 |
| 700– 799 | 79 | 5.1 | 749 | 736 | 21.9 | 1.5 | 5.0 | 45.6 | 13.4 | 2.5 | 1.9 | 8.2 |
| 800– 899 | 73 | 5.2 | 846 | 812 | 20.7 | 2.0 | 5.0 | 44.3 | 14.0 | 2.2 | 2.7 | 9.1 |
| 900– 999 | 63 | 5.1 | 942 | 907 | 19.0 | 1.5 | 5.1 | 44.7 | 14.6 | 2.6 | 2.6 | 9.9 |
| 1 000–1 099 | 31 | 5.0 | 1 044 | 1 009 | 18.1 | 1.8 | 4.5 | 44.7 | 15.5 | 2.5 | 1.5 | 11.4 |
| 1 100–1 199 | 18 | 5.0 | 1 137 | 1 103 | 16.2 | 1.9 | 3.8 | 45.6 | 14.9 | 2.5 | 3.6 | 11.5 |
| 1 200–1 299 | 8 | 5.4 | 1 256 | 1 249 | 19.8 | 2.2 | 3.8 | 45.0 | 15.2 | 2.2 | 1.3 | 10.5 |
| 1 300–1 399 | 8 | 4.9 | 1 344 | 1 312 | 16.8 | 1.1 | 3.6 | 43.6 | 13.7 | 4.9 | 1.1 | 15.2 |
| 1 500–1 599 | 6 | 4.7 | 1 518 | 1 556 | 16.3 | 1.2 | 4.1 | 36.8 | 16.8 | 2.3 | 7.4 | 15.1 |

From the foregoing it appears that the effect of the system of rates on congestion and on riding habit is not clear. In order to reach any conclusion as to the effect adoption of the zone system of fares would have on congestion in American cities, many factors other than cost of transportation must be taken into account. Prominent among these is time of journey. The time spent on a car is grudged by all, but by none more than by the man who works long hours at exhausting labor and whose rest is shortened by the amount of time spent in going to and returning from his work. The saving resulting from the payment of small rents is another important factor. This is indeed, in many cases, the determining cause of congestion, and in passing, it may be observed that there is always a tendency toward the capitalization by landlords of reduced transportation charges. Gregariousness also has its effect, and individuals and single families hesitate to separate themselves from those with whom they have been associated, even when they become financially able to move. This is especially to be noted in those communities where several races are living. It appears then that the rate of fare is only one of a number of factors which may affect congestion of population and from such data as is available it does not appear to be one of major importance.

One of the principal objections urged against the zone system is the difficulty of determining the fares and fare limits, and while these are important considerations, it does not appear that the difficulties are insurmountable. Three things must be kept in mind in any case:

1. The revenues of the company must not be impaired.
2. The fares should be so established that insofar as practicable, each patron will contribute to the revenues of the company in proportion as he contributes to its expenses.
3. Rates which, though equitable, would seriously affect the extent of patronage should be avoided insofar as possible.

In order to illustrate the application of these principles a typical case may be worked out.

The first step in this, as in other special problems, is the setting up of the functional income account for the property in the manner indicated in Chapter VII and elsewhere. Having done this, there are three methods of procedure by which the costs may be allocated to the several zones. These give substantially similar results, the choice of the method to be used in any case depending somewhat upon the availability of the necessary data. The first step in the application of each method is the determination of tentative zones. This can be best done by laying off on a large scale map half mile zones about the center of traffic. The boundaries of these areas should be carefully examined and should be adjusted by moving the points of intersection with tracks out or in, along the lines of track until the points coincide with distinct traffic points. In this way the fare limits will not be located with geometric precision but will conform to local traffic conditions.

Inasmuch as one of the chief advantages to be gained from the use of a zone system of fares is the possibility of meeting the demands for additional service which follow city growth, the fixing of zone limits should be done with careful consideration of the growth of population. Fig. 36, based on data prepared by Mr. Geo. Eberle, Electric Railway Statistician of the Railroad Commission of Wisconsin in a study of the traction problems of the city of Milwaukee, indicates a somewhat closer correlation between population and riding in the several zones than might be expected. The data from which this figure was prepared were obtained by a careful enumeration of the population living within one-fourth of a mile of and tributary to the car lines in each zone.

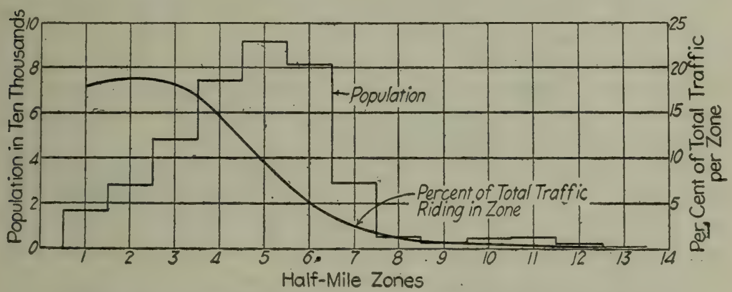



FIG. 36. SUMMARY,—POPULATION AND RIDING BY ZONES.

Fig. 37 shows roughly the outlines of the city and the zones drawn about the center of traffic. While Fig. 36 shows the summary of the results of the study of the various lines, Fig. 38, representing one line only and showing the same characteristics, indicates quite as clearly the relation between population and traffic. The route of the line shown in Fig. 38 is indicated in Fig. 37.

The second step consists in the allocation of the costs properly chargeable to each zone, and here the methods will be discussed separately.

Following the method used in Chapter XIV[1] in apportioning costs to a single mile of track, it is possible to apportion approximately to each zone the expenditures properly chargeable to it by multiplying the unit costs shown in the income account by the number of car hours, car miles, miles of track, and other units, as determined from an examination of the operation of the plant. The determination of these units for the several zones will entail an amount of work depending upon the extent and detail of the company's current records.

The second method is based upon the movements of passengers and consists in applying to the traffic in each zone the cost per passenger and per passenger mile as determined in Chapter XIV.[2] A tabulation of the passengers boarding and leaving cars in each

[1] Page 235, Table LX.
[2] Page 242.

zone on each line is necessary for the apportioning of the fixed or terminal costs, and a curve such as that shown in Fig. 26, is of assistance in determining the passenger miles in each zone. This information may be obtained by the use of methods described in Chapter X.

A third method makes use of the car as a unit and consists in assigning to each zone its proportionate part of the cost of each half round trip. The methods of determining costs per car mile and per half round trip have already been discussed in Chapter XIV. This method has as its chief advantage the facility with which the necessary data may be obtained.

Following the determination of the costs of operation within each zone, it is necessary to determine the extent of the traffic, the revenue from which must meet these costs. It is necessary to know the number of passengers entering the zone on cars and the number boarding cars within the zone. This information may be obtained in the same manner as the passenger data used in the second method of apportioning expenses to zones.

Having ascertained the costs to be met and the traffic, the scale of fares is next to be computed. There being certain costs that are independent of the length of ride, the amount of these which each passenger must bear, becomes the minimum fare. To this must be added the mileage charge.

The apportionment of revenues to the several zones should give half the fixed charge to the zone in which the passenger boards the car and half to the zone in which he leaves the car. The variable portion of the fare is to be prorated on a mileage basis.

For purposes of illustration there will be assumed an urban system, the functional income account for which is shown in the following table. In certain cases it may be advisable to use a somewhat more detailed form but usually the simpler form here shown, will suffice.

INCOME ACCOUNT

| ITEM | Amount | Number of units | Cost per unit |
|---|---|---|---|
| Operating revenue (total) | $2 000 000 | ............ | .......... |
| Cost of service (total)[1] | 2 000 000 | ............ | .......... |
| (*a*) Costs varying with car hour | 376 200 | 750 000 | 50.16 cents |
| (*b*) Costs varying with car mile | 305 600 | 7 000 000 | 4.37 cents |
| (*c*) Costs varying with mile of single track | 176 400 | 150 | $1176 |
| (*d*) Costs varying with number of passengers | 65 400 | 40 000 000 | 0.16 cents |
| (*e*) Costs of electrical energy (car mile) | 161 800 | 7 000 000 | 2.31 cents |
| (*f*) Administrative and overhead expense burden | 319 600 | [2] | 29.4% |
| (*g*) Return upon investment | 595 000 | | .......... |

[1] Includes Operating Expenses, Replacement Insurance, Taxes, and Return on Investment.
[2] Per cent items (*a*) to (*e*) inclusive.

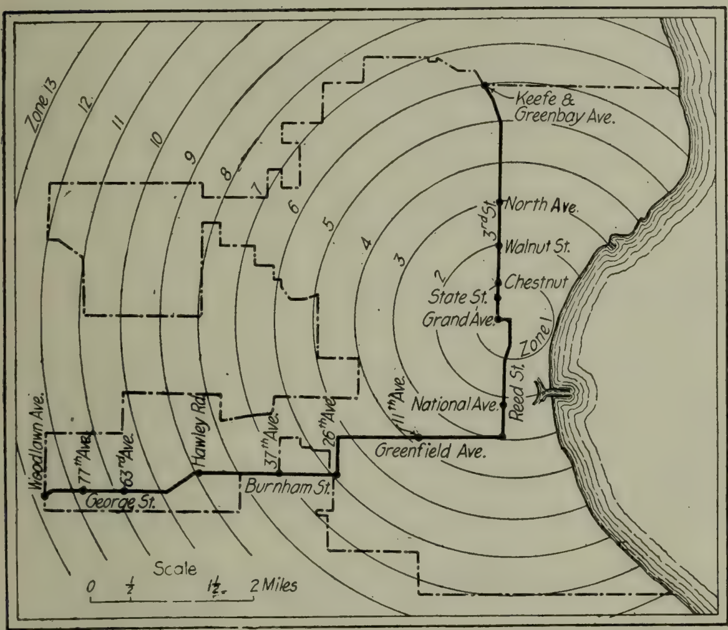



FIG. 37. LAYOUT OF ZONES AND TYPICAL CROSSTOWN LINE.

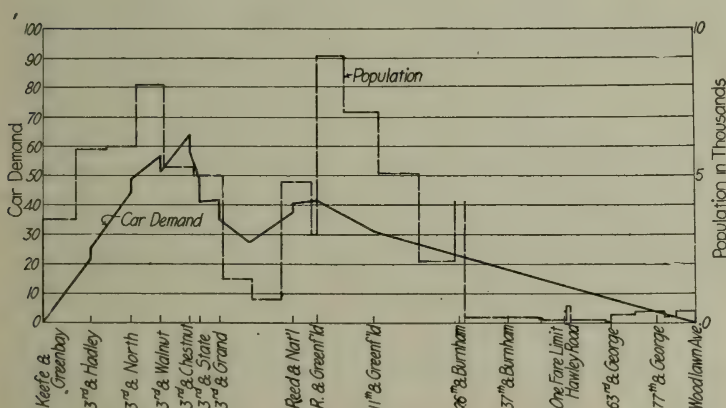



FIG. 38. RELATION BETWEEN POPULATION AND SERVICE REQUIRED, TYPICAL CROSSTOWN LINE.

From an examination of the property, the data shown in Table LXVI are obtained.

TABLE LXVII — PERCENTAGE DISTRIBUTION OF UNITS

| Item | Zones | | | | | |
|---|---|---|---|---|---|---|
| | 0–1 mile | 1–2 miles | 2–3 miles | 3–4 miles | 4–5 miles | 5–6 miles |
| Car hours | 23 | 22 | 22 | 15 | 12 | 6 |
| Car miles | 18.8 | 20 | 20 | 17.8 | 15.6 | 7.8 |
| Miles single track | 20 | 25 | 25 | 10 | 10 | 10 |
| Number of passengers | 40 | 12 | 6.4 | 9.6 | 20 | 12 |
| Investment | 30 | 26 | 25 | 9 | 6 | 4 |

It will be noted that zones one mile rather than one-half mile in width are taken. This is for the purpose of simplicity in illustration only.

Applying the percentages shown in Table LXVII to the costs shown in Table LXVI the total costs chargeable to the several zones are as indicated under method one in Table LXVIII.

TABLE LXVIII — ZONE COSTS

| Zone | Method | | |
|---|---|---|---|
| | I | II | III |
| 1 | $483 755 | $629 820 | $377 778 |
| 2 | 450 072 | 320 423 | 415 133 |
| 3 | 439 405 | 244 326 | 415 133 |
| 4 | 265 259 | 268 114 | 348 830 |
| 5 | 228 295 | 348 300 | 299 341 |
| 6 | 133 214 | 189 017 | 143 785 |
| Total | $2 000 000 | $2 000 000 | $2 000 000 |

Following the second method of apportioning costs to zones it is necessary first to determine the total fixed and variable expenses. These were found to be $1,281,940 and $718,060, respectively.

Table LXIX shows data on which the apportionment of these costs to the several zones may be made.

TABLE LXIX — PERCENTAGE DISTRIBUTION OF UNITS

| | Zones | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of passengers | 40 | 12 | 6.4 | 9.6 | 20 | 12 |
| Passenger miles | 16.3 | 23.2 | 22.6 | 20.2 | 12.8 | 4.9 |

Table LXVIII shows also the result of the determination of costs by the second method.

Applying the third method, it is first necessary to determine the fixed and variable costs. They are found to be 64.9 cents per car trip and 15.6 cents per car mile. A study of the schedules indicates a distribution of car trips as shown in Table LXX.

TABLE LXX — TRIP COSTS

| ZONES | Length in miles | Number of trips | Cost | |
|---|---|---|---|---|
| | | | Per trip | Total |
| | | | (*Cents*) | |
| 2 and 3 | 2 | 77 778 | 96.1 | $74 710 |
| 1, 2, and 3 | 3 | 77 778 | 111.7 | 86 845 |
| 1, 2, 3, and 4 | 4 | 155 556 | 127.3 | 197 955 |
| 1, 2, 3, 4, and 5 | 5 | 544 444 | 142.9 | 777 780 |
| 1, 2, 3, 4, 5, and 6 | 6 | 544 444 | 158.5 | 862 710 |
| Totals | ........ | 1 400 000 | ........ | $2 000 000 |

Apportioning the costs shown in Table LXX, the results shown under method three, Table LXVIII, are obtained.

These costs as determined by the several methods might be met by any one of a number of systems of charges. Four rates of fare are shown in Table LXXI, computed as there indicated by assuming the fixed charge per passenger at 1, 2, 3 and 4 cents and calculating for each case the corresponding charge per passenger mile so that with the number of passengers and of passenger miles assumed above, the revenues will meet the costs of service.

TABLE LXXI — RATES OF FARE

| SCALE OF FARE | Cents per | |
|---|---|---|
| | Mile | Passenger |
| A | 1.16 | 1 |
| B | .87 | 2 |
| C | .58 | 3 |
| D | .29 | 4 |

Applying these rates of fare, the revenues which will be produced are as indicated in Table LXXII.

TABLE LXXII — REVENUES AT DIFFERENT RATES OF FARE

| Zone | Scale of Fare | | | |
|---|---|---|---|---|
| | A | B | C | D |
| 1 | $421,000 | $515,000 | $610,000 | $705,000 |
| 2 | 419,000 | 375,000 | 330,000 | 285,000 |
| 3 | 387 600 | 322 200 | 257 800 | 192 400 |
| 4 | 361 400 | 318 800 | 277 200 | 234 600 |
| 5 | 285 000 | 314 000 | 342 000 | 371 000 |
| 6 | 126 000 | 155 000 | 183 000 | 212 000 |
| Totals | $2 000 000 | $2 000 000 | $2 000 000 | $2 000 000 |

Comparing Tables LXXII and LXVIII, it is observed that Scale A most nearly satisfies the requirements of Methods I and III, while Scale C is more accurate in the case of Method II.

Tabulating the original traffic data from which passengers and passenger miles were determined, the result is as shown in Table LXXIII.

TABLE LXXIII — REVENUE UNDER PROPOSED SCALE OF FARE

| Between Zones | Number of passengers | Miles each | Fare scale A | Fare scale B | Fare scale C | Fare scale D | Proposed scale | Revenue under proposed scale |
|---|---|---|---|---|---|---|---|---|
| | | | *(Cents)* | *(Cents)* | *(Cents)* | *(Cents)* | *(Cents)* | |
| 1 and 1...<br>1 and 2... | 4 800 000 | 1.2 | 2.92 | 3.04 | 3.70 | 4.35 | 3 | $144 000 |
| 1 and 3... | 3 200 000 | 2.2 | 4.52 | 3.91 | 4.28 | 4.64 | 4 | 128 000 |
| 1 and 4... | 5 120 000 | 3.2 | 6.12 | 4.78 | 4.86 | 4.93 | 5 | 256 000 |
| 1 and 5... | 12 800 000 | 4.2 | 7.73 | 5.65 | 5.44 | 5.22 | 6 | 768 000 |
| 1 and 6... | 6 080 000 | 5.4 | 9.65 | 6.70 | 6.13 | 5.58 | 7 | 425 600 |
| 2 and 2...<br>2 and 3... | 320 000 | 1.2 | 2.92 | 3.04 | 3.70 | 4.35 | 3 | 9 600 |
| 2 and 4... | 640 000 | 2.2 | 4.52 | 3.91 | 4.28 | 4.64 | 4 | 25 600 |
| 2 and 5... | 1 920 000 | 3.2 | 6.12 | 4.78 | 4.86 | 4.93 | 5 | 96 000 |
| 2 and 6... | 1 920 000 | 4.4 | 7.73 | 5.65 | 5.44 | 5.22 | 6 | 115 200 |
| 3 and 3...<br>3 and 4... | 320 000 | 1.2 | 2.92 | 3.04 | 3.70 | 4.35 | 3 | 9 600 |
| 3 and 5... | 640 000 | 2.2 | 4.52 | 3.91 | 4.28 | 4.64 | 4 | 25 600 |
| 3 and 6... | 640 000 | 3.4 | 6.12 | 4.78 | 4.86 | 4.93 | 5 | 32 000 |
| 4 and 4...<br>4 and 5... | 640 000 | 1.2 | 2.92 | 3.04 | 3.70 | 4.35 | 3 | 19 200 |
| 4 and 6... | 960 000 | 2.4 | 4.52 | 3.91 | 4.28 | 4.64 | 4 | 38 400 |
| Total..... | 40 000 000 | ..... | ..... | ..... | ..... | ..... | ...... | $2 091 800 |

From this, the rate which suggests itself as meeting the requirements reasonably well and as being easy of application is three cents for any trip confined to one or two zones with an additional charge of one cent for each additional zone entered.

Apportioning the revenues accruing under this scale of fares to the several zones on the basis of fixed charges divided equally between the initial and terminal zone of each ride and movement charges on the basis of mileage, the results are as shown in Table LXXIV.

TABLE LXXIV — ZONE REVENUES — PROPOSED SCALE OF FARES

| ZONE | Revenues |
|---|---|
| 1 | $527 200 |
| 2 | 403 200 |
| 3 | 341 200 |
| 4 | 341 100 |
| 5 | 322 100 |
| 6 | 157 000 |
| Total | $2 091 800 |

In the preceding paragraphs, the unit costs are determined on the basis of the operation of the whole system. It may occur in the case of companies operating through several community centers that it will be practicable to segregate costs for the various localities served. Take, for example, a system operating in and between one large and one small city. In this case, in computing the fare between them, overlapping zones concentric about the two communities would be disregarded and the fare made up by adding half the terminal cost per passenger in the large city to half the terminal cost per passenger in the small city, and to this amount adding the mileage rate in each, times the miles made in each. Local traffic in each city would be charged on the basis of the unit costs determined by a study of traffic and costs therein.

### *Conclusion*

Many questions of detail which are not fully discussed here will arise in the working out of a zone system of fares for application to the lines of any company. Most of them, however, will not materially affect the results and it should be borne in mind, too, that such computations as those illustrated in this chapter are not of a sort that can be carried to conclusions of complete precision. There is, of course, no necessity for such results and the purpose of studies of this kind will be served if they act as a reliable guide in developing a rational and nondiscriminatory system of fares.

From the foregoing discussion, it would appear that the belief that the zone system of fares tends to produce congestion of population is not proven from a review of the available data.

Congestion is due principally to the time required in transportation, savings resulting from the payment of lower rents, from gregariousness and from other social factors. The rate of fare is only one of

a number of factors which may affect such congestion and the nature of its effect is not clear nor is its extent great.

No examination has been made of the questions of collection and accounting involved in the application of the zone fares. From the experiences cited, these difficulties do not appear to be serious.

It appears that some system of fares other than a flat rate is necessary in order to apportion between long and short haul riders the costs which they respectively occasion.

It is also evident that some system, such as zone charges, is necessary if extensions of lines are to be made from time to time without unduly burdening traffic other than that availing itself of the additional service.

# CHAPTER XVI

## COST OF COMPLYING WITH STANDARDS OF SERVICE

Effect on Cost of Variation of Number of Car Hours Required Under Service Standards at Various Periods During the Day,—— Cost as a Function of Concentration of Service,—— Typical Problem Analyzed: (1) Analysis of Cost of Service During Various Hours of the Day; (2) Effect on Cost of Increase in Rush-Hour Service; (3) Effect on Cost of Uniform Service Throughout Twenty-Four Hours,—— Comparison of Cost per Car Hour and Return on Investment During Various Periods of the Day Under Above Conditions.

Previous chapters have dealt with the problems of traffic surveys and service standards without reference to the effect of additional service on cost, and it will be of interest here to point out by a concrete example how the variation from time to time in the number of required car hours affects the cost of operation.

It is obvious that while the average total cost per car hour may be $2.75, it will cost the traction company very much more than $27.50 to place ten cars in service for an hour at the time of the evening rush. In fact, this difference in cost is so great that with the usual variation in demand for service it is impossible at current rates of fare to provide service which will maintain a constant ratio between seats and passengers. The standard of car loading which will provide the most liberal service at least cost must permit more passengers per car during rush-hours than during other periods of the day.

In the following example the conclusion is evident that due to the high cost of rush-hour service, the use of a modified standard of car loading at peak will permit a saving of 350 car hours, which, with advantage to the patrons and at the same cost to the company, can be replaced by 890 car hours during other periods of the day — a net gain of 540 car hours. The result in the case assumed is the seating of 16,950 more passengers out of a total of 300,000 riding.

The varying car hour costs, calculated by methods later discussed, are shown in Table LXXV.

This table shows the costs per car hour at different periods of the day and the cost for each increase in the number of car hours per hour. It will be noted that an increase of 3,650 car hours over the service rendered from 6 to 7 a. m. costs $6.00 per hour, and a similar increase from 160,600 to 164,250 car hours during the evening peak costs $11.50 per car hour. These costs indicate that car hours added in conformity with set standards of service must be associated with the time of day in which the additions occur.

A second way of stating these results involves a measure of the concentration of the service rendered as shown by the cars in service at different hours of the day. Were the schedule uniform throughout the 24 hours, that is, were there no concentration, it is obvious that

10 per cent of the service would be rendered in 10 per cent of the time, 20 per cent of the service in 20 per cent of the time, 70 per cent of the service in 70 per cent of the time, etc. In the present case, however, it was found that in one hour, or 4.16 per cent of the time, only one per cent of the total car hours was furnished; in the six hours when the fewest cars were in service, or 25 per cent of the time,

Table LXXV — Increment Costs per Car Hour

| Period of Day | Car hours per hour per period of day | Increment in "car hour per hour" | Total costs per hour per period of day | Increment in total costs | Cost per car hour per period of day | Cost per car hour for each increment in "car hours per hour" |
|---|---|---|---|---|---|---|
| 12 a. m.– 5 a. m. | 6 570 | ...... | $17 322 | ........ | $2.635 | $2.635 |
| 5 a. m.– 6 a. m. | 41 975 | 35 405 | 101 778 | $84 456 | 2.420 | 2.385 |
| 8 p. m.–12 p. m. | 70 445 | 28 470 | 170 436 | 68 658 | 2.420 | 2.410 |
| 9 a. m.– 4 p. m. | 77 745 | 7 300 | 189 612 | 19 176 | 2.440 | 2.620 |
| 7 p. m.– 8 p. m. | 99 280 | 21 535 | 248 676 | 59 064 | 2.510 | 2.745 |
| 8 a. m.– 9 a. m. | 118 625 | 19 345 | 323 059 | 74 383 | 2.725 | 3.840 |
| 4 p. m.– 5 p. m. | 122 275 | 3 650 | 340 673 | 17 614 | 2.785 | 4.825 |
| 6 a. m.– 7 a. m. | 127 750 | 5 475 | 366 206 | 25 533 | 2.870 | 4.655 |
| 7 a. m.– 8 a. m. | 131 400 | 3 650 | 388 058 | 21 852 | 2.958 | 6.000 |
| 6 p. m.– 7 p. m. | 160 600 | 29 200 | 573 459 | 185 401 | 3.570 | 6.350 |
| 5 p. m.– 6 p. m. | 164 250 | 3 650 | 615 449 | 41 990 | 3.735 | 11.500 |

Note.— This table is based on one year's operation.

7.67 per cent of the car hours were in service; in 75 per cent of the time, 52.67 per cent of the car hours, etc. These results are more fully set forth in Table LXXVI and Fig. 39.

Table LXXVI — Concentration Index

| Per cent of time | Per cent of car hours | Difference | Per cent of time | Per cent of car hours | Difference |
|---|---|---|---|---|---|
| 4.16 | 1.00 | 3.16 | 54.16 | 30.33 | 23.83 |
| 8.33 | 2.00 | 6.33 | 58.33 | 34.66 | 23.66 |
| 12.50 | 3.00 | 9.50 | 62.50 | 39.00 | 23.50 |
| 16.66 | 4.33 | 12.33 | 66.66 | 43.33 | 23.50 |
| 20.83 | 6.00 | 14.83 | 70.83 | 48.00 | 22.83 |
| 25.00 | 7.66 | 17.33 | 75.00 | 52.66 | 22.33 |
| 29.16 | 10.00 | 19.16 | 79.16 | 58.00 | 21.16 |
| 33.33 | 12.33 | 21.00 | 83.33 | 64.00 | 19.33 |
| 37.50 | 15.00 | 22.50 | 87.50 | 72.00 | 15.50 |
| 41.66 | 18.66 | 23.00 | 91.66 | 80.00 | 11.66 |
| 45.83 | 22.33 | 23.50 | 95.83 | 89.33 | 6.50 |
| 50.00 | 26.33 | 23.66 | 100.00 | 100.00 | 0 |
| Total difference or index of concentration | | | | | 410 |

In the table the sum of the differences is used to measure the amount by which the service varies from uniformity or the index of concentration. This index is found to be 410. A company with less pronounced peak load would show a smaller concentration index and one

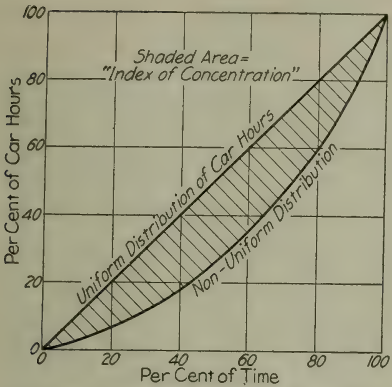



FIG 39. INDEX OF CONCENTRATION.

with a peak greater than normal a larger index due to the greater deviation from uniformity. A graphical representation of the data in Table LXXVI is shown in Fig. 39 and is in the form frequently employed in statistical studies of the concentration of wealth. The straight diagonal line represents uniformity of distribution or no concentration. The curved line drawn between the same points as the diagonal line shows the actual distribution of service. The area between the two lines is a measure of the departure from uniformity of the variable, that is, the per cent of car hours. The shaded area represents the sum of the differences in percentages of car hours and shows graphically the degree of concentration.

The difference in cost of the same service for indices of concentration varying from 0 to 425 is shown graphically in Fig. 40.

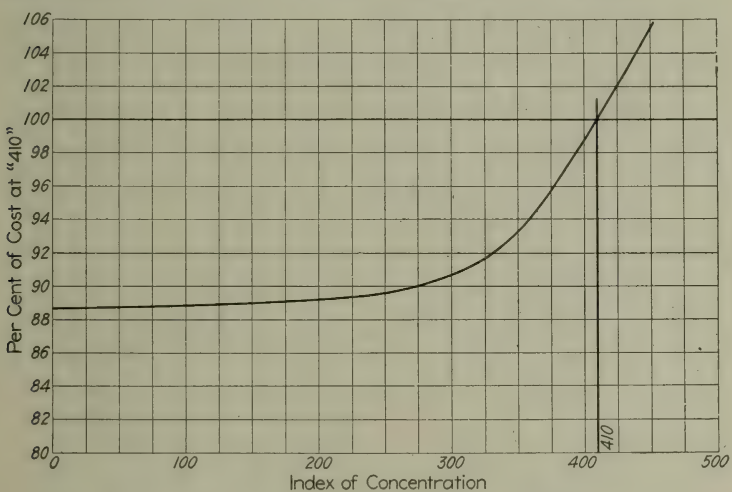



FIG. 40.— COST AS A FUNCTION OF CONCENTRATION

The practical application of these costs to the standard of service will be apparent upon an examination of the loading diagram, Fig. 41, showing seats and passengers during a typical 24-hour period. The

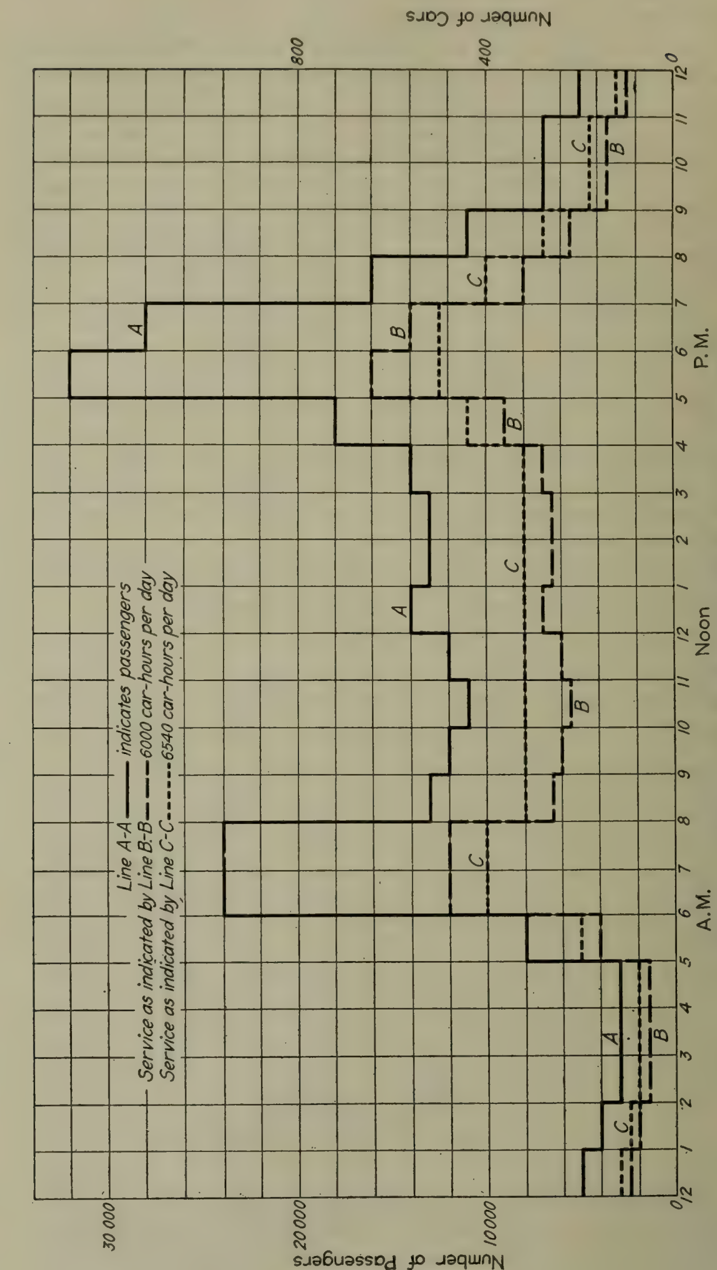



FIG. 41.—VARIATION OF SERVICE WITH UNCHANGED COST

line A-A in this figure represents passengers and the line B-B cars now in service at each hour. It will be observed that the line B-B follows proportionately the variations in the line A-A, keeping constant the relation between service and traffic. The data in Table LXXVI conforms to line B-B and discloses a deviation from uniformity or index of concentration of 410. Assuming that 6 000 car hours per day distributed as indicated by the line B-B exhaust the financial ability of the company to provide service at present rates of fare, it will be found by reference to Fig. 40 that if service can be so distributed as to reduce the index of concentration from 410 to 325, the cost per car hour will be but 91.7 per cent as great and consequently the number of car hours which the company can supply daily at the same cost will be 6 000 divided by 0.917 or 6 540. Service on the basis is shown by the line C-C in Fig. 41.

It is of interest to note that the 160 car hours in the morning and the 190 car hours in the evening rush hours or 350 in all, have been replaced with 890 car hours during other periods of the day, leaving a net gain of 540 car hours.

Assuming that the line C-C in Fig. 41 represents service sufficient to provide a seat per passenger from 8 a. m. to 4 p. m., it will be of interest to observe the relative service furnished under the two plans indicated by the lines C-C and B-B, as measured by the percentage of passengers seated at the point of maximum loading.

Following the method of procedure previously outlined, Table LXXVII has been computed and it is found that the advantage of lower off peak costs has been utilized to seat about 17,000 additional passengers out of a total of 300 000 or 5.6 per cent. The ratio of seats to passengers throughout the day has been increased from 82 to 87.5 per cent. The ratio of seats to passengers during the period 5-6 p. m. has been decreased from 82 to 65 per cent.

In the above computations, it is assumed that the average length of ride is the same throughout the day, and that the same routing is employed under schedules C-C and B-B. This permits the quality of service to be measured by the number of passengers standing at the point of heaviest loading. A more critical analysis would consider in addition the relative mileage of standing passengers. There is no question, however, that schedule C-C is the more economical and satisfactory standard of service.

It is obvious then that when it is proposed to establish standards of service, either by stating directly the number of cars to be run during different periods of the day or by fixing car capacities, it becomes a matter of considerable importance to ascertain the cost of complying with such standards. In fact, the ability of the company to meet this cost without an unreasonable reduction in the earnings becomes the test of the reasonableness of such service requirements.

Following the method pursued in previous chapters, there will be

taken up the detailed analysis of cost involved in the solution of the general problem:

(1) What is the cost of service at present during the various hours of the day and what is the return on investment during these hours?

(2) What will be the effect on costs of an increase in service during certain hours and what will be the effect of such an increase in service on the return on investment during the various hours?

TABLE LXXVII — ADVANTAGE OF VARIABLE STANDARD OF LOADING

| Hour | Total number of passengers | Line C-C in Fig. 41; Index of concentration 324.7 Cost factor, 92 | | Line B-B in Fig. 41; Index of concentration 410 Cost factor, 100 | |
|---|---|---|---|---|---|
| | | Number of cars | Number of seated passengers | Number of cars | Number of seated passengers |
| 12– 1 a. m. | 5 000 | 118 | 4 820 | 100 | 4 100 |
| 1– 2 " | 4 000 | 100 | 4 000 | 80 | 3 270 |
| 2– 3 " | 3 000 | 80 | 3 000 | 60 | 2 450 |
| 3– 4 " | 3 000 | 80 | 3 000 | 60 | 2 450 |
| 4– 5 " | 3 000 | 80 | 3 000 | 60 | 2 450 |
| 5– 6 " | 8 000 | 200 | 8 000 | 160 | 6 550 |
| 6– 7 " | 24 000 | 400 | 16 350 | 480 | 19 630 |
| 7– 8 " | 24 000 | 400 | 16 350 | 480 | 19 630 |
| 8– 9 " | 13 000 | 313 | 12 800 | 260 | 10 630 |
| 9–10 " | 12 000 | 313 | 12 000 | 240 | 9 825 |
| 10–11 " | 11 000 | 313 | 11 000 | 220 | 9 000 |
| 11–12 " | 12 000 | 313 | 12 000 | 240 | 9 825 |
| 12– 1 p. m. | 14 000 | 313 | 12 800 | 280 | 11 450 |
| 1– 2 " | 13 000 | 313 | 12 800 | 260 | 10 630 |
| 2– 3 " | 13 000 | 313 | 12 800 | 260 | 10 630 |
| 3– 4 " | 14 000 | 313 | 12 800 | 280 | 11 450 |
| 4– 5 " | 18 000 | 440 | 18 000 | 360 | 14 720 |
| 5– 6 " | 32 000 | 505 | 20 650 | 640 | 26 170 |
| 6– 7 " | 28 000 | 505 | 20 650 | 560 | 22 900 |
| 7– 8 " | 16 000 | 400 | 16 000 | 320 | 13 100 |
| 8– 9 " | 11 000 | 270 | 11 000 | 220 | 9 000 |
| 9–10 " | 7 000 | 170 | 6 950 | 140 | 5 720 |
| 10–11 " | 7 000 | 170 | 6 950 | 140 | 5 720 |
| 11–12 " | 5 000 | 118 | 4 820 | 100 | 4 100 |
| Total | 300 000 | 6 540 | 262 540 | 6 000 | 245 400 |
| Per cent of total | ........ | ........ | 87.5 | ........ | 81.8 |

These determinations will differ with each traction company. Rush hour service is largely a local problem and its extent depends upon the lay-out of the transportation system, the location of business, residence, factory and amusement sections and the extent of supplementary and competing forms of transportation. Rather than complicate the discussion by considering the effect of various conditions in large and small traction systems, a typical traction company has been selected for the purpose of illustrating the computations of cost.

The urban transportation system assumed has operating revenues of \$4 500 000, an investment of \$20 000 000, and expenses as set forth in Table LXXVIII.

TABLE LXXVIII — CONDENSED INCOME ACCOUNT

| Item | Amount |
|---|---|
| Operating Revenues (total) | \$4 500 000 |
| Operating Expenses (total) | 3 453 000 |
| Operating Expenses (including replacement insurance) | 3 093 000 |
| Taxes | 360 000 |
| Net Operating Revenue | 1 047 000 |
| Amount necessary to yield 8 per cent. return on value of property | 1 600 000 |
| Actual rate of return on value of property (Per cent) | 5.235 |

The present service during the rush-hour period of two hours from 5 to 7 p. m. requires 450 cars as compared with 213 cars on regular runs during the non-rush period. The load curve for a typical day is shown in Fig. 42. The relation of the number of passengers handled

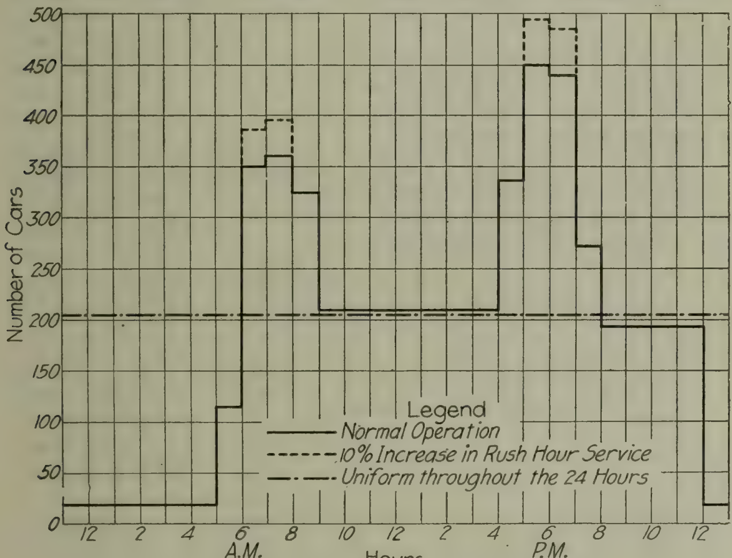



FIG. 42.— LOAD CURVE FOR A TYPICAL DAY.

during the maximum hour to the average number handled per hour throughout the year or the "index of traffic" is 2.76 and the relation of the number of cars in service during the maximum hour to the average number in service throughout the year or the "index of service" is 2.16. These ratios are not unusual. In fact, in many cases

the existing diversity between rush and non-rush service will be found to be greater than has been here assumed. In a considerable number of cases examined, the traffic ratio or index varies from 2.58 to 5.55 and the service index from about 2 to 3. This would indicate that the assumptions of diversity of traffic and service are conservative and that the effect on operating income of increased rush-hour service is likely to be greater in practice than would appear from these computations.

The first step in the analysis consists in the preparation of a functional income account as described in Chapter VII and applied in previous analyses in Chapters XIV and XV. In this income account operating expenses are grouped in accordance with the unit of comparison with which the expense item varies. Table LXXIX is such an income account under present conditions of operation.

Table LXXIX — Functional Income Account — Normal Operation

| Item | Amount in Dollars | Number of units | Amount per unit |
|---|---|---|---|
| | | | (*Cents*) |
| Operating Revenue | $4 500 000 | 90 000 000 | 0.05 |
| Operating Expenses (including replacement insurance) | 3 093 000 | .......... | .......... |
| Variable operating cost varying with: | | | |
| Car Miles | 633 345 | 16 242 500 | 0.03899 |
| Car Hours | 17 472 | 1 825 000 | 0.00957 |
| Number of passengers | 122 174 | 90 000 000 | 0.00135 |
| Cars Handled | 140 980 | 406 000 | 0.347 |
| Platform labor | 917 278 | .......... | .......... |
| Car hours (90%) | 825 550 | 1 825 000 | 0.452 |
| Layover and guarantee (10%) (No. of runs) | 91 728 | .......... | .......... |
| Power | 365 863 | .......... | .......... |
| Car Miles (66.95%) | 244 938 | 16 242 500 | 0.0151 |
| Standby costs (33.05%) | 120 925 | .......... | .......... |
| Fixed Operating Cost based on | 895 888 | .......... | .......... |
| Miles of track | 372 204 | .......... | (*Dollars*) |
| Number of cars owned | 202 827 | 450 | 450 70 |
| Power capacity | 170 815 | 20 000 | 85 40 |
| General overhead and administrative expense | 150 042 | .......... | .......... |
| Net Operating Revenue | 1 407 000 | .......... | .......... |
| Fixed Charges (Taxes @ 1.8% and interest @ 8%) related to | 1 960 000 | .......... | .......... |
| Miles of track | 353 780 | .......... | .......... |
| Number of cars owned | 398 840 | 450 | 886 30 |
| Investment in power equipment | 372 812 | 20 000 | 18 60 |
| General and administrative expense | 834 568 | .......... | .......... |
| Deficit | 553 000 | .......... | .......... |
| Actual Rate of Return (Per cent) | 5.235 | .......... | .......... |

The second step involves the prorating of costs to the various periods of the day. The considerations involved in these apportionments may be briefly described. The operating revenues to be credited

to each period are determined directly from register records, or from periodic traffic counts. Likewise car miles and car hours for each period are available from the analysis of schedules. The number of passengers is here taken to vary directly as the revenue but when the rate of fare is not constant throughout the day, the number of passengers and the revenue must be determined separately.

The car handlings chargeable to each hour's operation should be determined as follows: The time at which each car is taken out should be noted together with the time it is returned to the barn, and each hour or part of an hour of this elapsed time should be charged with a pro rata share of the handling. For example, a car leaves the barn at 6.30 a. m. and returns at 9.30 a. m. The hour from 6 to 7 a. m. should therefore be charged with one-sixth of a handling, that from 7 to 8 with one-third, that from 8 to 9 with one-third, and that from 9 to 10 a. m. with one-sixth. When the results of this computation have been summarized by hours the percentage of handlings attributable to each period may be readily determined.

The apportionment of platform labor to the several periods involves a recognition of two elements which contribute to this item of expenditure. The first is the hourly rate of pay and this portion of the expenditure is directly chargeable to the various hours of the day in proportion to the car hours run during each. The second portion of the cost of platform labor is that due to payment for non-running time. This is of two kinds: that allowed at the beginning and end of each run; and that allowed in order to make the weekly wage of certain platform men equal a guaranteed minimum. These amounts should be determined by inspecting the scheduled runs and the payroll and when listed should be divided between the different hours of the runs of the men to whom paid in the same manner as car handling costs are apportioned to the hours covered by the runs.

Power costs are likewise composed of two different elements, energy costs and standby costs. Energy costs may be taken to vary with the car mileage made, except in cases where the character or speed of the equipment in service at different hours differ so as to cause a considerable variation in the power consumption per car mile. To determine standby costs it is necessary to analyze power plant conditions and to note the part of labor and fuel cost that is expended before and after each generating unit is thrown into service. Such costs should be apportioned to the several hours during which each unit is in service and the percentage of the total of these costs properly chargeable thereto determined for each hour.

The apportionment of the remaining operating costs is made in the following manner: The expenses which are determined to vary with the miles of track, and those expenses which are termed general overhead and administrative expenses are apportioned between the various hours of the day on the basis of the number of passengers. It has been pointed out in connection with previous studies that these ex-

penses are in the nature of a general tax on the traffic as a whole and are more closely related to the readiness of the company to serve than to the actual service rendered. The apportionment of these items, then, between the various hours has been made on the basis of the number of passengers riding during each. Certain of the fixed operating expenses are determined to vary with the number of cars owned. In examining the use of the rolling stock, it appears that the investment in certain cars is necessary only because of the demand for service during two or three hours per day. It is evident then that the other costs arising out of the number of cars owned must be apportioned in the case of each car to the service rendered during the hours which it is operated. When the number of hours each car is in service each day is determined a table can be constructed showing the proper distribution of the participation in car costs of the various hours of the day. If, for instance, a car is taken out at 6 a. m. and returned at 9 a. m. and is again in service for the four hours from 4 to 8 p. m., each of the hours should be charged with one-seventh of the fixed costs of that car. It is apparent that a car in service for a large number of hours per day will occasion a smaller burden for fixed charges per car hour than a car whose use is limited to few hours under prevailing standards of service. It should be noted that the costs here under consideration are not those varying with the extent of the use of any car but fixed costs such as those expenditures for maintenance which will occur irrespective of the extent of the use to which the car is put.

The operating expenses grouped as a function of power capacity are those which will occur in substantially the same amount whether power equipment is being operated or not, and which depend rather on the extent of the investment in power plant. The distribution of these expenses between the various hours is made on the basis of the particular hours each of the several units of power equipment is in service. The computation to be performed in this apportionment is similar to that indicated in the apportionment of car demand costs.

The fixed charges in the income account are made up entirely of taxes and return on the investment and both are considered to vary with the extent of the investment. For other than *ad valorem* taxes, a correction should be made to take into account the nature of the tax. The total fixed charges are first apportioned as to those which vary with the miles of track, those which vary with the investment in cars, those which vary with the investment in power equipment, and those which are in the nature of a general and administrative expense burden. The first and fourth of these are apportioned between the various hours of the day in the same manner as the similar items of fixed operating expenses were apportioned and for the same reasons. Those expenses which vary with the number of cars owned are apportioned on the percentage relation determined from a study of the car demand at various hours and those fixed charges varying

TABLE LXXX — PERCENTAGE APPORTIONMENT OF UNIT COSTS BY OPERATING PERIODS BEFORE CONTEMPLATED INCREASE IN SERVICE OVER NORMAL CONDITIONS OF OPERATION

| Unit | 24 hours | A. M. | | | | | | P. M. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12–5 | 5–6 | 6–7 | 7–8 | 8–9 | 9–4 | 4–5 | 5–6 | 6–7 | 7–8 | 8–12 |
| Passengers and gross earnings | 100.00 | 1.00 | 2.00 | 8.50 | 8.75 | 6.50 | 26.75 | 7.00 | 11.50 | 10.50 | 5.50 | 12.00 |
| Car miles | 100.00 | 2.39 | 2.55 | 6.21 | 6.38 | 5.76 | 33.06 | 5.94 | 7.98 | 7.80 | 4.82 | 17.11 |
| Car hours | 100.00 | 1.80 | 2.30 | 7.00 | 7.20 | 6.50 | 29.82 | 6.70 | 9.00 | 8.80 | 5.44 | 15.44 |
| Platform labor (total) | 100.00 | 1.74 | 2.23 | 7.16 | 7.41 | 6.56 | 28.90 | 6.81 | 9.61 | 9.35 | 5.27 | 14.96 |
| Platform labor-layover and guarantee | 100.00 | 1.20 | 1.60 | 8.60 | 9.30 | 7.10 | 20.62 | 7.80 | 15.10 | 14.30 | 3.74 | 10.64 |
| Car house handlings | 100.00 | 1.22 | 1.08 | 10.12 | 11.75 | 8.09 | 14.04 | 7.83 | 18.00 | 16.37 | 4.42 | 7.08 |
| Power costs (total) | 100.00 | 1.60 | 2.13 | 7.27 | 7.57 | 6.62 | 28.23 | 6.87 | 10.05 | 9.70 | 5.37 | 14.59 |
| Power costs — standby costs | 100.00 | ...... | 1.28 | 9.42 | 9.98 | 8.36 | 18.45 | 8.75 | 14.24 | 13.55 | 6.48 | 9.49 |
| Power plant investment | 100.00 | 0.83 | 1.31 | 7.69 | 8.45 | 6.43 | 18.06 | 6.86 | 19.56 | 17.34 | 4.46 | 9.01 |
| Car investment | 100.00 | 1.60 | 1.42 | 7.56 | 8.29 | 6.35 | 18.45 | 6.76 | 18.98 | 16.84 | 4.45 | 9.30 |

with investment in power equipment are likewise apportioned on the demand basis. It should be noted that costs varying with the investment in cars and in power plant are apportioned on the basis of percentages determined from an analysis of cars and power equipment in service regularly, thus effectually spreading the costs connected with reserve equipment over equipment regularly operated.

The computations briefly described above may be considerably simplified by the use of load curves and standard forms for the summary of data.

In Table LXXX are summarized the percentage apportionments of unit costs under present conditions of operation for the typical company under discussion and in Table LXXXI are shown the income accounts for the several hours, obtained by apportioning the expenses on the basis of the percentages shown in Table LXXX. From Table LXXXI it is evident that the return on the company's investment earned during the various hours of the day is not uniform and that in those hours when the traffic is the most dense, the rate of return is particularly low.

If by means of a proposed service standard the company is required to increase the number of cars in service during the four hours of heaviest traffic — that is, from 6 to 8 a. m. and from 5 to 7 p. m.— the net revenues of the company will be seriously affected and it is the purpose of the following computation to determine as definitely as possible what this effect will be. Certain of the statistical units of operation will be increased and an examination of the proposed schedules indicates that the amount of these increases as reflected in the various units of comparison will be as stated in Table LXXXII.

Table LXXXII — Per Cent of Increase Arising From 10 Per Cent Increase in Car Hours During Periods 6–8 a. m. and 5–7 p. m.

| Item | Increase |
|---|---|
| | *(Per cent)* |
| Passengers | None |
| Car miles | 2.84 |
| Car hours | 3.20 |
| Platform labor | 3.88 |
| Car house handlings | 13.27 |
| Power costs | 3.72 |
| Power plant investment | 10.00 |
| Car investment | 10.00 |

If these increases are applied to the income account as shown in Table III, it will be possible to set up a new income account showing the results of the proposed increase in service. Table LXXXIII indicates that both operating expenses and fixed charges will be increased and that while rendering additional service the company will incur an annual deficit of $753 000, this being an increase over the deficit under the present conditions of operation of about $200,000.

TABLE LXXXI.—INCOME ACCOUNT APPORTIONED TO OPERATING PERIODS BEFORE CONTEMPLATED INCREASE IN SERVICE

| | | A. M. | | | | | | P. M. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24 hours | 12–5 | 5–6 | 6–7 | 7–8 | 8–9 | 9–4 | 4–5 | 5–6 | 6–7 | 7–8 | 8–12 |
| Operating revenue | $4 500 000 | $45 000 | $90 000 | $382 500 | $393 750 | $292 500 | $1 203 750 | $315 000 | $517 500 | $472 500 | $247 500 | $540 000 |
| Operating expenses (including replacement insurance) | 3 093 000 | 50 093 | 64 331 | 230 343 | 241 533 | 199 165 | 843 407 | 207 972 | 348 425 | 326 709 | 157 783 | 423 239 |
| Variable operating cost varying with | 2 197 112 | 40 208 | 48 768 | 157 482 | 164 588 | 141 357 | 635 433 | 145 986 | 216 459 | 208 099 | 112 416 | 326 316 |
| Car miles | 633 345 | 15 137 | 16 151 | 39 332 | 40 409 | 36 482 | 209 370 | 37 622 | 50 542 | 49 402 | 30 528 | 108 370 |
| Car hours | 17 472 | 314 | 402 | 1 223 | 1 258 | 1 136 | 5 210 | 1 171 | 1 572 | 1 537 | 950 | 2 699 |
| Number of passengers | 122 174 | 1 222 | 2 444 | 10 385 | 10 690 | 7 941 | 32 681 | 8 552 | 14 050 | 12 828 | 6 720 | 14 661 |
| Cars handled | 140 980 | 1 720 | 1 523 | 14 267 | 16 565 | 11 405 | 19 794 | 11 039 | 25 376 | 23 078 | 6 231 | 9 982 |
| Platform labor | 917 278 | 15 961 | 20 455 | 65 677 | 67 970 | 60 173 | 265 095 | 62 467 | 88 150 | 85 765 | 48 340 | 137 225 |
| Car hours | 825 550 | 14 860 | 18 988 | 57 788 | 59 440 | 53 661 | 246 179 | 55 312 | 74 299 | 72 648 | 44 910 | 127 465 |
| Layover and guarantee | 91 728 | 1 101 | 1 467 | 7 889 | 8 530 | 6 512 | 18 916 | 7 155 | 13 851 | 13 117 | 3 430 | 9 760 |
| Power | 365 863 | 5 854 | 7 793 | 26 598 | 27 696 | 24 220 | 103 283 | 25 135 | 36 769 | 35 489 | 19 647 | 53 379 |
| Car miles | 244 938 | 5 854 | 6 246 | 15 211 | 15 627 | 14 108 | 80 977 | 14 549 | 19 546 | 19 105 | 11 806 | 41 909 |
| Standby costs | 120 925 | ...... | 1 547 | 11 387 | 12 069 | 10 112 | 22 306 | 10 586 | 17 223 | 16 384 | 7 841 | 11 470 |
| Fixed operating cost based on | 895 888 | 9 885 | 15 563 | 72 861 | 76 945 | 57 808 | 207 974 | 61 986 | 131 966 | 118 610 | 45 367 | 96 923 |
| Miles of track | 372 204 | 3 722 | 7 444 | 31 637 | 32 568 | 24 193 | 99 566 | 26 054 | 42 803 | 39 081 | 20 471 | 44 665 |
| Number of cars owned | 202 827 | 3 245 | 2 880 | 15 334 | 16 814 | 12 879 | 37 422 | 13 711 | 38 497 | 34 156 | 9 026 | 18 863 |
| Power capacity | 170 815 | 1 418 | 2 238 | 13 136 | 14 434 | 10 983 | 30 850 | 11 718 | 33 411 | 29 619 | 7 618 | 15 390 |
| General overhead and administrative expense | 150 042 | 1 500 | 3 001 | 12 754 | 13 129 | 9 753 | 40 136 | 10 503 | 17 255 | 15 754 | 8 252 | 18 005 |
| Net operating revenue | 1 407 000 | D *5 093* | 25 669 | 152 157 | 152 217 | 93 335 | 360 343 | 107 028 | 169 075 | 145 791 | 89 717 | 116 761 |
| Fixed charges (taxes and interest at 8 per cent), related to | 1 960 000 | 21 359 | 34 315 | 159 830 | 168 548 | 126 541 | 458 797 | 135 722 | 285 282 | 256 588 | 99 734 | 213 284 |
| Miles of track | 353 780 | 3 538 | 7 076 | 30 071 | 30 956 | 22 996 | 94 634 | 24 765 | 40 685 | 37 147 | 19 458 | 42 454 |
| Number of cars owned | 398 840 | 6 381 | 5 664 | 30 152 | 33 064 | 25 326 | 73 586 | 26 962 | 75 700 | 67 165 | 17 748 | 37 092 |
| Investment in power equipment | 372 812 | 3 094 | 4 884 | 28 669 | 31 503 | 23 972 | 67 330 | 25 575 | 72 922 | 64 646 | 16 627 | 33 590 |
| General and administrative expense | 834 568 | 8 346 | 16 691 | 70 938 | 73 025 | 54 247 | 223 247 | 58 420 | 95 975 | 87 630 | 45 901 | 100 148 |
| Deficit | *$553 000* | *$26 452* | *$8 646* | *$7 673* | *$16 331* | *$33 206* | *$98 454* | *$28 694* | *$116 207* | *$110 797* | *$10 017* | *$96 523* |
| Actual rate of return (per cent) | 5.235 | —4.14 | 5.53 | 7.53 | 7.05 | 5.43 | 5.90 | 5.93 | 4.01 | 3.77 | 7.02 | 3.57 |

D = deficit.

TABLE LXXXIII — INCOME ACCOUNT
TEN PER CENT INCREASE IN RUSH-HOUR SERVICE

| ITEM | Amount in dollars | Number of units |
|---|---|---|
| Operating revenue | $4 500 000 | 90 000 000 |
| Operating expenses (including replacement insurance) | 3 216 622 | ........... |
| Variable operating cost, varying with | 2 283 399 | ........... |
| Car miles | 651 281 | 16 703 787 |
| Car hours | 18 024 | 1 883 400 |
| Number of passengers | 122 174 | 90 000 000 |
| Cars handled | 159 577 | 459 876 |
| Platform labor | 952 868 | ........... |
| Car hours | 851 297 | 1 883 400 |
| Layover and guarantee | 101 571 | (10.66%) |
| Power | 379 475 | ........... |
| Car miles | 252 227 | 16 703 787 |
| Standby costs | 127 248 | (33.53%) |
| Fixed Operating cost based on | 933 223 | ........... |
| Miles of track | 372 204 | ........... |
| Number of cars owned | 223 097 | 495 |
| Power capacity | 187 880 | 22 000 |
| General overhead and administrative expense | 150 042 | ........... |
| Net Operating revenue | 1 283 378 | ........... |
| Fixed charges (taxes and interest @ 8%) related to | 2 036 267 | ........... |
| Miles of track | 353 780 | ........... |
| Number of cars owned | 438 719 | 495 |
| Investment in power equipment | 409 200 | 22 000 |
| General and administrative expense | 834 568 | ........... |
| Deficit | 752 889 | ........... |
| Actual rate of return (Per cent) | 4.376 | ........... |

Proceeding in the method outlined above, there may be determined the proper charges to be made against operation during each hour of the day, and Table LXXXIV shows the percentage basis of such an apportionment. Applying these percentages to the income account, Table LXXXIII, it is possible to set up income accounts for each of the several periods, which is done in Table LXXXV. From an examination of this table, it is seen that the addition of 10 per cent to the service during the four heaviest hours of the day serves to decrease the rate of return very materially, and to place a burden upon the company which amounts to a practical confiscation of its property during these hours.

For comparative purposes, it will be worth while to consider what the effect would be upon costs if it were possible to furnish service uniformity throughout the 24 hours. Table LXXXVI, Part I, indicates the decreases which would occur in the various units and Table LXXXVI, Part II, shows the income account of the company under such decreased costs. From this income account it is apparent that the prevailing rate of return would be practically doubled were it not for conditions of peak load operation.

TABLE LXXXIV — PERCENTAGE APPORTIONMENT OF UNIT COSTS BY OPERATING PERIODS AFTER CONTEMPLATED INCREASE IN SERVICE OVER NORMAL CONDITIONS OF OPERATION

| Unit | 24 hours | A. M. | | | | | | P. M. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12–5 | 5–6 | 6–7 | 7–8 | 8–9 | 9–4 | 4–5 | 5–6 | 6–7 | 7–8 | 8–12 |
| Passengers and gross earnings | 100.00 | 1.00 | 2.00 | 8.50 | 8.75 | 6.50 | 26.75 | 7.00 | 11.50 | 10.50 | 5.50 | 12.00 |
| Car miles | 100.00 | 2.33 | 2.48 | 6.64 | 6.83 | 5.60 | 32.13 | 5.78 | 8.53 | 8.35 | 4.69 | 16.64 |
| Car hours | 100.00 | 1.74 | 2.23 | 7.46 | 7.67 | 6.30 | 28.91 | 6.49 | 9.59 | 9.38 | 5.27 | 14.96 |
| Platform labor (total) | 100.00 | 1.68 | 2.15 | 7.71 | 7.98 | 6.31 | 27.82 | 6.55 | 10.29 | 10.03 | 5.08 | 14.40 |
| Platform labor — Layover and guarantee | 100.00 | 1.18 | 1.48 | 9.80 | 10.58 | 6.39 | 18.68 | 7.05 | 16.16 | 15.48 | 3.49 | 9.71 |
| Car house handlings | 100.00 | 1.08 | 0.96 | 11.46 | 13.04 | 7.15 | 12.40 | 6.92 | 19.21 | 17.63 | 3.91 | 6.24 |
| Power costs (total) | 100.00 | 1.54 | 2.06 | 7.78 | 8.03 | 6.40 | 27.29 | 6.64 | 10.68 | 10.29 | 5.19 | 14.10 |
| Power costs — standby costs | 100.00 | ...... | 1.20 | 10.04 | 10.40 | 7.99 | 17.70 | 8.35 | 14.94 | 14.14 | 6.18 | 9.06 |
| Power plant investment | 100.00 | 0.76 | 1.19 | 8.76 | 9.52 | 5.84 | 16.42 | 6.24 | 20.63 | 18.40 | 4.05 | 8.19 |
| Car investment | 100.00 | 1.46 | 1.30 | 8.61 | 9.33 | 5.79 | 16.82 | 6.17 | 20.06 | 17.91 | 4.06 | 8.49 |

TABLE LXXXV — INCOME ACCOUNT APPORTIONED TO OPERATING PERIODS AFTER CONTEMPLATED INCREASE IN SERVICE

| | 24 hours | A. M. | | | | | | P. M. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12–5 | 5–6 | 6–7 | 7–8 | 8–9 | 9–4 | 4–5 | 5–6 | 6–7 | 7–8 | 8–12 |
| Operating revenue | $4 500 000 | $45 000 | $90 000 | $382 500 | $393 750 | $292 500 | $1 203 750 | $315 000 | $517 500 | $472 500 | $247 500 | $540 000 |
| Operating expenses (including replacement insurance) | 3 216 622 | 50 193 | 64 414 | 256 309 | 268 272 | 199 207 | 843 657 | 208 065 | 384 137 | 361 017 | 157 946 | 423 405 |
| Variable operating cost, varying with | 2 283 399 | 40 286 | 48 833 | 176 252 | 183 874 | 141 371 | 635 581 | 146 019 | 240 566 | 231 655 | 112 555 | 326 407 |
| Car miles | 651 281 | 15 175 | 16 152 | 43 245 | 44 482 | 36 472 | 209 257 | 37 644 | 55 554 | 54 382 | 30 545 | 108 373 |
| Car hours | 18 024 | 314 | 402 | 1 345 | 1 382 | 1 136 | 5 209 | 1 170 | 1 729 | 1 691 | 950 | 2 696 |
| Number of passengers | 122 174 | 1 222 | 2 443 | 10 385 | 10 690 | 7 941 | 32 682 | 8 552 | 14 050 | 12 828 | 6 720 | 14 661 |
| Cars handled | 159 577 | 1 723 | 1 532 | 18 288 | 20 809 | 11 410 | 19 787 | 11 043 | 30 655 | 28 133 | 6 239 | 9 958 |
| Platform labor | 952 868 | 60 008 | 20 487 | 73 466 | 76 039 | 60 126 | 265 087 | 62 413 | 98 050 | 95 573 | 48 406 | 137 213 |
| Car hours | 851 297 | 14 812 | 18 984 | 63 507 | 65 294 | 53 632 | 246 111 | 55 249 | 81 639 | 79 852 | 44 863 | 127 354 |
| Layover and guarantee | 101 571 | 1 196 | 1 503 | 9 959 | 10 745 | 6 494 | 18 976 | 7 164 | 16 411 | 15 721 | 3 543 | 9 859 |
| Power | 379 475 | 5 844 | 7 817 | 29 523 | 30 472 | 24 286 | 103 559 | 25 197 | 40 528 | 39 048 | 19 695 | 53 506 |
| Car miles | 252 227 | 5 844 | 6 288 | 16 748 | 17 227 | 14 125 | 81 041 | 14 578 | 21 515 | 21 061 | 11 829 | 41 971 |
| Standby costs | 127 248 | ...... | 1 529 | 12 775 | 13 245 | 10 161 | 22 518 | 10 619 | 19 013 | 17 987 | 7 866 | 11 535 |
| Fixed operating cost based on | 933 223 | 9 907 | 15 581 | 80 057 | 84 398 | 57 836 | 208 076 | 62 046 | 143 571 | 129 362 | 45 391 | 96 998 |
| Miles of track | 372 204 | 3 722 | 7 444 | 31 637 | 32 568 | 24 193 | 99 565 | 26 054 | 42 803 | 39 081 | 20 472 | 44 665 |
| Number of cars owned | 223 097 | 3 257 | 2 900 | 19 208 | 20 815 | 12 918 | 37 525 | 13 765 | 44 753 | 39 957 | 9 058 | 18 941 |
| Power capacity | 187 880 | 1 428 | 2 236 | 16 458 | 17 886 | 10 972 | 30 850 | 11 724 | 38 760 | 34 570 | 7 609 | 15 387 |
| General overhead and administrative expense | 150 042 | 1 500 | 3 001 | 12 754 | 13 129 | 9 753 | 40 136 | 10 503 | 17 255 | 15 754 | 8 252 | 18 005 |
| Net operating revenue | 1 283 378 | *D 5 193* | 25 586 | 126 191 | 125 478 | 93 293 | 360 093 | 106 935 | 133 363 | 111 483 | 89 554 | 116 595 |
| Fixed charges (taxes and interest at 8 per cent) related to | 2 036 267 | 21 399 | 34 339 | 174 629 | 183 869 | 126 541 | 458 867 | 135 788 | 309 085 | 278 645 | 99 743 | 213 362 |
| Miles of track | 353 780 | 3 538 | 7 076 | 30 071 | 30 956 | 22 995 | 94 636 | 24 765 | 40 685 | 37 147 | 19 457 | 42 454 |
| Number of cars owned | 438 719 | 6 405 | 5 703 | 37 774 | 40 932 | 25 402 | 73 793 | 27 069 | 88 007 | 78 575 | 17 812 | 37 247 |
| Investment in power equipment | 409 200 | 3 110 | 4 869 | 35 846 | 38 956 | 23 897 | 67 191 | 25 534 | 84 418 | 75 293 | 16 573 | 33 513 |
| General and administrative expense | 834 568 | 8 346 | 16 691 | 70 938 | 73 025 | 54 247 | 223 247 | 58 420 | 95 975 | 87 630 | 15 901 | 100 148 |
| Deficit | *752 889* | *26 592* | *8 753* | *48 438* | *58 391* | *33 248* | *98 774* | *28 853* | *175 722* | *167 162* | *10 189* | *96 767* |
| Actual rate of return (per cent) | 4.376 | —4.18 | 5.50 | 5.28 | 4.89 | 5.42 | 5.89 | 5.92 | 2.43 | 2.12 | 6.99 | 3.56 |

D = deficit.

TABLE LXXXVI — PART I — PER CENT OF DECREASE ARISING FROM EQUALIZATION OF SERVICE OVER 24 HOURS

| Item | Per cent decrease |
|---|---|
| Passengers | None |
| Car miles | None |
| Car hours | None |
| Platform labor | 10.0 |
| Car house handlings | 49.2 |
| Power costs | 23.7 |
| Power plant investment | 53.8 |
| Car investment | 53.8 |

TABLE LXXXVI — PART II — FUNCTIONAL INCOME ACCOUNT — SERVICE UNIFORM THROUGHOUT THE 24 HOURS

| Item | Number of units | Amount | Amount per hour |
|---|---|---|---|
| Operating revenue | 90 000 000 | $4 500 000 | $187 500 |
| Operating expenses (including replacement insurance) | .......... | 2 644 326 | 110 181 |
| Variable operating cost varying with | .......... | 1 949 339 | 81 223 |
| Car miles | 16 242 500 | 633 345 | 26 390 |
| Car hours | 1 825 000 | 17 472 | 728 |
| Number of passengers | 90 000 000 | 122 174 | 5 091 |
| Cars handled | 206 250 | 71 569 | 2 982 |
| Platform labor | .......... | 825 550 | 34 398 |
| Car hours | 1 825 000 | 825 550 | 34 398 |
| Layover and guarantee | .......... | .......... | .......... |
| Power | .......... | 279 229 | 11 634 |
| Car miles | 16. 242 500 | 244 938 | 10 205 |
| Standby costs | (14%) | 34 291 | 1 429 |
| Fixed operating cost based on | .......... | 694 987 | 28 957 |
| Miles of track | .......... | 372 204 | 15 509 |
| Number of cars owned | 208 | 93 746 | 3 906 |
| Power capacity | 9 250 | 78 995 | 3 291 |
| General overhead and administrative expense | .......... | 150 042 | 6 251 |
| Net operating revenue | .......... | 1 855 674 | 77 319 |
| Fixed charges (Taxes and interest @ 8%) | .......... | 1 536 145 | 64 006 |
| Miles of track | .......... | 353 780 | 14 741 |
| Number of cars owned | 208 | 184 350 | 7 681 |
| Investment in power equipment | 9.250 | 163 447 | 6 811 |
| General and administrative expense | .......... | 834 568 | 34 773 |
| Surplus | .......... | 319 529 | 13 313 |
| Actual rate of return (Per cent) | .......... | 10.05 | 10.05 |

Summarized, the condensed income accounts under present conditions of operation, under operation with service increased 10 per cent during rush hours and under uniform operation throughout the 24 hours, give results as indicated in Table LXXXVII.

TABLE LXXXVII — CONDENSED INCOME ACCOUNT

| Item | Normal operation (a) | 10% increase in rush-hour service (b) | Service uniform throughout 24 hours (c) | Per cent (b) of (a) | Per cent (c) of (a) |
|---|---|---|---|---|---|
| Operating revenue (total) | $4 500 000 | $4 500 000 | $4 500 000 | 100.00 | 100.00 |
| Operating expenses (total) | 3 453 000 | 3 590 622 | 2 926 470 | 103.98 | 84.75 |
| Operating expenses, including replacement insurance | 3 093 000 | 3 216 622 | 2 644 326 | 104.00 | 85.49 |
| Taxes | 360 000 | 374 000 | 282 144 | 103.88 | 78.37 |
| Net operating revenue | 1 047 000 | 909 378 | 1 573 530 | 86.85 | 150.28 |
| Amount necessary to yield 8% return on value of property | 1 600 000 | 1 662 267 | 1 254 001 | 103.89 | 78.37 |
| Actual rate of return on value of property (per cent) | 5.235 | 4.376 | 10.05 | 83.59 | 191.97 |

Table LXXXVIII shows the cost per passenger at various periods of the day under the three assumptions as to the service rendered and from these tables it is evident that the popular belief that the strap hanger pays the dividends is fallacious. There is also indicated the reasonableness of charging double fares for owl service, and the fact that reduced rates for workingmen's tickets good during rush-hours are unwarranted upon the basis of cost.

Table LXXXIX shows condensed income accounts for the various peak loads in cents per car hour.

In the typical case assumed, the results of the proposed change in rush-hour service are found to be as follows:

### RELATIVE COST OF SERVICE DURING VARIOUS HOURS

The relative cost of service during the hours 5 to 7 p. m. will be 24.08 per cent of the total cost of service or 3.49 times the cost during this period, were the entire service furnished at a uniform rate throughout the twenty-four hours.

### COST OF ADDITIONAL SERVICE

An increase of 10 per cent in service during the rush-hours will increase the proportion of the cost during the hours 5 to 7 p. m. to 25.37 per cent or 3.83 times the cost for this period, were the entire service furnished uniformly throughout the 24 hours.

The net operating revenues contributed by rush-hour service which, under assumed normal conditions, yield 3.89 per cent upon the investment devoted to its use, or approximately one-fifth of the total revenue, will be decreased by this increase in rush-hour service to 2.29 per cent, or approximately one-seventh of the total. The changes in the relative cost and profit of the service for various periods of the day occasioned by the increase of 10 per cent in service during the hours 6 to 8 a. m. and 5 to 7 p. m. are as shown in Table XC.

Table LXXXVIII — Cost per Passenger During Various Periods

| Number of Passengers | Period | Operating expense, including taxes and replacement insurance, but excluding return | | Return at 8% on value of property apportioned to service | | Total costs | |
|---|---|---|---|---|---|---|---|
| | | Amount *Dollars* | Per Passenger *Cents* | Amount *Dollars* | Per Passenger *Cents* | Amount *Dollars* | Per Passenger *Cents* |
| | | | *Under Conditions of Normal Operation* | | | | |
| 900 000 | 12-5 a. m. | 54 016 | 6.00 | 17 436 | 1.94 | 71 452 | 7.94 |
| 1 800 000 | 5-6 | 70 634 | 3.92 | 28 012 | 1.56 | 98 646 | 5.48 |
| 7 650 000 | 6-7 | 259 700 | 3.39 | 130 473 | 1.71 | 390 173 | 5.10 |
| 7 875 000 | 7-8 | 272 491 | 3.46 | 137 590 | 1.74 | 410 081 | 5.20 |
| 5 850 000 | 8-9 | 222 407 | 3.80 | 103 299 | 1.77 | 325 706 | 5.57 |
| 24 075 000 | 9 a. m.-4 p. m. | 927 675 | 3.85 | 374 529 | 1.56 | 1 302 204 | 5.41 |
| 6 300 000 | 4-5 | 232 901 | 3.69 | 110 793 | 1.76 | 343 694 | 5.45 |
| 10 350 000 | 5-6 | 400 824 | 3.87 | 232 883 | 2.25 | 633 707 | 6.12 |
| 9 450 000 | 6-7 | 373 837 | 3.95 | 209 460 | 2.22 | 583 297 | 6.17 |
| 4 950 000 | 7-8 | 176 101 | 3.56 | 81 416 | 1.64 | 257 517 | 5.20 |
| 10 800 000 | 8-12 | 462 414 | 4.28 | 174 109 | 1.61 | 636 523 | 5.89 |
| 90 000 000 | 24 hours | 3 453 000 | 3.83 | 1 600 000 | 1.78 | 5 053 000 | 5.61 |
| | | | *Under a 10 Per Cent Increase in Rush-hour Service* | | | | |
| 900 000 | 12-5 a. m. | 54 183 | 6.02 | 17 409 | 1.93 | 71 592 | 7.95 |
| 1 800 000 | 5-6 | 70 721 | 3.93 | 28 032 | 1.55 | 98 753 | 5.48 |
| 7 650 000 | 6-7 | 288 384 | 3.77 | 142 554 | 1.86 | 430 938 | 5.63 |
| 7 875 000 | 7-8 | 302 044 | 3.83 | 150 097 | 1.91 | 452 141 | 5.74 |
| 5 850 000 | 8-9 | 222 449 | 3.80 | 103 299 | 1.76 | 325 748 | 5.56 |
| 24 075 000 | 9 a. m.-4 p. m. | 927 939 | 3.86 | 374 585 | 1.55 | 1 302 524 | 5.41 |
| 6 300 000 | 4-5 | 233 006 | 3.69 | 110 847 | 1.76 | 343 853 | 5.45 |
| 10 350 000 | 5-6 | 440 908 | 4.26 | 252 314 | 2.43 | 693 222 | 6.69 |
| 9 450 000 | 6-7 | 412 197 | 4.36 | 227 465 | 2.41 | 639 662 | 6.77 |
| 4 950 000 | 7-8 | 176 266 | 3.56 | 81 423 | 1.64 | 257 689 | 5.20 |
| 10 800 000 | 8-12 | [illegible]62 594 | 4.28 | 174 173 | 1.61 | 636 767 | 5.89 |
| 90 000 000 | 24 hours | 3 590 622 | 3.99 | 1 662 267 | 1.84 | 5 252 889 | 5.83 |
| | | | *Under Service Uniform Throughout 24 Hours* | | | | |
| 90 000 000 | 24 hours | 2 926 470 | 3.25 | 1 254 001 | 1.39 | 4 180 471 | 4.64 |

TABLE LXXXIX — INCOME ACCOUNT UNDER VARIOUS PEAK LOADS

| ITEM | 24-hours per car hour | 6–7 a. m. per car hour | 7–8 p. m. per car hour | 5–6 p. m. per car hour | 6–7 p. m. per car hour |
|---|---|---|---|---|---|
| *Under conditions of normal operation* | | | | | |
| | *(Dollars)* | *(Dollars)* | *(Dollars)* | *(Dollars)* | *(Dollars)* |
| Operating revenue (total).... | 2.47 | 2.99 | 2.99 | 3.15 | 2.94 |
| Operating expenses (total).... | 1.89 | 2.03 | 2.07 | 2.44 | 2.33 |
| Operating expenses including replacement insurance | 1.69 | 1.80 | 1.83 | 2.12 | 2.03 |
| Taxes.................... | 0.20 | 0.23 | 0.24 | 0.32 | 0.29 |
| Net operating revenue....... | 0.57 | 0.96 | 0.92 | 0.71 | 0.61 |
| Amount necessary to yield 8% return on value of property. | 0.88 | 1.02 | 1.05 | 1.42 | 1.30 |
| Actual rate of return on value of property (Per cent)..... | 5.235 | 7.53 | 7.05 | 4.01 | 3.77 |
| *Deficit*.................... | *0.30* | *0.06* | *0.12* | *0.71* | *0.69* |
| Car hours................... | 1 825 000 | 127 750 | 131 400 | 164 250 | 160 600 |
| *Under a 10% increase in rush hour service* | | | | | |
| Operating revenues (total)... | 2.39 | 2.72 | 2.72 | 2.86 | 2.67 |
| Operating expenses (total).... | 1.90 | 2.04 | 2.08 | 2.44 | 2.33 |
| Operating expenses including replacement insurance | 1.71 | 1.82 | 1.85 | 2.13 | 2.04 |
| Taxes.................... | 0.19 | 0.22 | 0.23 | 0.31 | 0.29 |
| Net operating revenue....... | 0.49 | 0.68 | 0.64 | 0.42 | 0.34 |
| Amount necessary to yield 8% return on value of property. | 0.88 | 1.01 | 1.04 | 1.39 | 1.28 |
| Actual rate of return on value of property (Per cent)..... | 4.376 | 5.28 | 4.89 | 2.43 | 2.12 |
| *Deficit*.................... | *0.39* | *0.33* | *0.40* | *0.97* | *0.94* |
| Car hours................... | 1 883 400 | 140 525 | 144 540 | 180 675 | 176 660 |
| *Under service uniform throughout 24 hours* | | | | | |
| Operating revenues (total)... | 2.47 | 2.47 | 2.47 | 2.47 | 2.47 |
| Operating expenses (total).... | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 |
| Operating expenses including replacement insurance | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 |
| Taxes.................... | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Net operating revenues...... | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| Amount necessary to yield 8% return on value of property. | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| Surplus.................... | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Car hours................... | 1 825 000 | 76 041 | 76 041 | 76 041 | 76 041 |
| Actual rate of return on apportioned value of property. | 10.05% | 10.05% | 10.05% | 10.05% | 10.05 |

TABLE XC — RATE OF RETURN DURING VARIOUS OPERATING PERIODS

| PERIOD OF DAY | Normal operation | Ten per cent additional service added at rush hours | Service uniform throughout 24 hours |
|---|---|---|---|
| 12– 5 a. m. | D 4.14 | D 4.18 | 10.05 |
| 5– 6 " | 5.53 | 5.50 | 10.05 |
| 6– 7 " | 7.53 | 5.28 | 10.05 |
| 7– 8 " | 7.05 | 4.89 | 10.05 |
| 8– 9 " | 5.43 | 5.42 | 10.05 |
| 9– 4 p. m. | 5.90 | 5.89 | 10.05 |
| 4– 5 " | 5.93 | 5.92 | 10.05 |
| 5– 6 " | 4.01 | 2.43 | 10.05 |
| 6– 7 " | 3.77 | 2.12 | 10.05 |
| 7– 8 " | 7.02 | 6.99 | 10.05 |
| 8–12 " | 3.57 | 3.56 | 10.05 |
| 24 hours | 5.235 | 4.376 | 10.05 |

D = Deficit.

The increased unit costs following increased service at the peak are found to be due to a number of conditions among which the most important are the following:

(1) Operating expenses for platform labor are materially increased per car hour run where additional service is furnished for short periods. Under usual operating conditions, only a limited number of men can be secured for rush-hour service at the usual rates, in anticipation of advancement to full day runs. Additional inducements must be made, in order to secure labor for a few hours per day. The operating conditions of the company do not readily present other types of employment by which such labor can be employed during non-rush hours in order to constitute a full day's work.

(2) Rush-hour service creates a peak on the generating plant and the cost per kw-hr. for electrical energy for cars is much increased during such peak periods. Investment in necessary generator and transmission capacity must lie idle during the greater portion of the day and in readiness for rush-hour service. The ordinary fixed charges upon such investment cannot be spread over the company's output, as would be the case if the service furnished had a demand uniform throughout the 24 hours.

(3) The liability of accident during rush-hours is proportionately greater than during non-rush hours, due to the congested condition of the streets and the haste of passengers at these periods. This item was not evaluated in the preceding computations.

(4) Investment in additional cars, car housing facilities and car handling facilities being idle during the non-rush hour period of

the day, fixed charges upon such investment are accordingly higher per unit of service during the rush hours.

It is also interesting to note that the increased service from 5 to 7 p. m. of 32,431 car hours resulted in an increased cost of $115,880, or at the rate of $3.57 per car hour, while the average cost per car hour is only $2.77 throughout the day. The increased service in the period 6 to 8 a. m. of 25,809 car hours resulted in an increased cost of $82,825, or at the rate of $3.21 per car hour. The morning increase did not necessitate any addition to plant and permitted greater use of certain existing facilities. Had this increase from 6 to 8 a. m. not occurred, the cost per car hour for the increased evening service would have been appreciably higher than $3.57. Excluding return on investment, these figures become $2.42 for the cost per car hour of additional evening rush-hour service, and $2.26 per car hour for additional service during the morning rush, as compared with the figure $1.89 for the average cost per car hour throughout the day, excluding return on investment.

# CHAPTER XVII

## COST OF EXTENDING THE TRANSFER PRIVILEGE

Growth of the Transfer Privilege and Effect on Revenues and Cost of Service,—— Causes of Increase of Transfer Ratio,—— Advantages and Disadvantages of Free Transfers,—— Typical Problem Analyzed: Effect on Revenue; Diversion of Traffic from Old to New Routes; Possibility of Fraud; Influence on Riding Habit; Influence of Number of Rides on Cost,— Results of a Charge for Transfers.

The constant growth in the use of the free transfer has caused, as has been pointed out in Chapter IV,[1] a steady decline in the average fare per ride. There have been other results arising out of the use of the free transfer which, while not so obvious, are by no means negligible. Not only has the use of the free transfer decreased the average fare and increased the cost of operation but it has come to be considered a right instead of a privilege as in the past, and as a result there is a constant demand for further extensions frequently such as to impose serious burdens both of an operating and a financial character. It is proposed to discuss in this chapter some of the factors which must be given consideration when the probable cost of such extensions is to be determined.

The early street railways did not issue transfers since the lines were short and designed primarily to furnish local service. Usually a city contained a number of independent lines, and diverse ownership effectively prevented the use of transfers. During the early nineties, there began the movement toward electrification and consolidation. These changes, representing additional investment, required a greater density of traffic and led to strong attempts at traffic stimulation. The dominant idea among street railway men of that day was the education of the average man and woman to habitual riding. A liberal free transfer system was believed to be a means to that end and was in consequence vigorously advocated. In some cities, it was promoted by the struggle for traffic between competing lines. It is true that there was some fear of fraud in connection with the use of transfers, but in the majority of cases there was little realization of the burdens that a general transfer system was to force upon street railways in the near future.[2] Moreover, certain improvements in the art of electric railway transportation, together with the low cost of labor and materials in the early nineties brought about a considerable reduction in operating costs.

---

[1] See Chapter IV — Tendency of Operating Costs, Fig. 8.

[2] C. D. Wyman — 1895 Proceedings of the *American Street Railway Association*, pp. 55–57. "I shall talk in favor of a broad and liberal use of transfers * * * Riding upon a street car is to a very large extent a habit * * * transfers come in * * * to make it convenient * * * pleasant, and to put an additional inducement for the cultivation of this good practice, the advantage of a general ride."

The desire to stimulate traffic led in some instances to a reduction in the rate of fare. Many of the street railways at the time saw the difficulties attendant upon reduced fares and advocated as a public concession free transfers, instead.[1]

The consolidation of separately owned and operated lines enabled certain street railway companies to save considerable car mileage. This saving was accomplished by re-routing cars to fit more closely the main currents of traffic. This eliminated indirect routing for the majority of patrons and still permitted those who wished to reach points removed from the main routes to do so by the use of transfers to routes on which the service was somewhat less frequent than upon the main thoroughfare. The situation was similar to that encountered by steam roads in straightening lines. The construction of a "cut off" may permit the saving of many train miles but it is necessary to maintain some service for the community which was formerly served by the original and circuitous route. The supplementary service is in the nature of a feeder to the main lines but economy does not permit the routing of through trains over branch lines.

While these considerations were and still remain the economic bases of the use of transfers, an examination of many urban systems of the present will indicate how far from this conception the transfer practices have developed. With the growth of cities in area and the consolidation of all surface transportation utilities under the same corporation, the use of transfers has gradually contributed to increased length of passenger haul until in many cities at the present time a considerable portion of the patrons receive service costing the company in excess of the fare paid. The growing extent of long rides would impose no insuperable burden if there was a similar increase in the extent of short rides, but this the free transfer also contrives to prevent through the conversion of short revenue riding into transfer riding.[2] Where this has occurred serious financial difficulties have inevitably followed.

The period of consolidation was immediately followed by one of extension requiring new franchises. These were often not to be obtained without some concessions on the part of the street railways. One of the concessions most frequently asked from promoters by city councils and other franchise-issuing bodies was reduced fares for some one class in the community. Another concession was the issue of free transfers and though these were originally issued voluntarily, it was now insisted that their future issue be made a franchise pro-

---

[1] C. D. Wyman — 1895 Proceedings *American Street Railway Association*, pp. 55–57. "It (reducing fares) is the greatest mistake in the world and one that is going to lead to endless future troubles, to say nothing of bankruptcies * * * You do not reduce your fare specially (by giving free transfers); you cultivate the habit of riding; more than that you give pleasure to the people."

[2] It is interesting to note that the present difficulties were anticipated in the early discussions of the transfer privilege. See C. S. Sergeant — 1895 Proceedings of the *American Street Railway Association*, pp. 64–65.

vision. Since the period was one of growth and general prosperity, street railway promoters often conceded this point.[1]

The advantages of the free transfer may be summed up as follows:

(1) It stimulates riding.

(2) It permits the saving of car miles through the use of shorter and more direct routes for the heavier currents of traffic.

The disadvantages of the free transfer may in turn be summarized as follows:

(1) There is chance of fraud in connection with its use, both on the part of employes and patrons.[3]

(2) It causes a substantial decrease in the revenue per ride.[2]

(3) It increases the expenses arising out of injury and damage claims.

(4) It changes some short revenue riding into free riding.[3, 4]

The first of these disadvantages has been given a great deal of attention and by the use of careful inspection and occasional prosecutions has been kept in check. The possibilities of misuse of transfers are much greater in the case of "double transfers" or "transfers on transfers" and while it is possible to eliminate the greater part of fraudulent use, the cost of so doing is by no means an inconsiderable item.

The effect of the free transfer on the average revenue per ride has been discussed in some detail in Chapter IV.

The effect of transfer practice on the cost of injuries and damages arises from boarding and alighting accidents which are increased through transferring passengers. This constitutes one of the elements of cost attendant upon a transfer system and must be given consideration in the extension of transfer privileges.[3]

The fourth objection to which reference has already been made is perhaps of greatest importance. The fundamental danger of the free transfer lies in the fact that it greatly reduces the short haul

---

[1] Robert McCulloch — 1895 Proceedings of the *American Street Railway Association* p. 67. "* * * within a week after you voluntarily go into the transfer business the public claim it as a right and give you no credit whatever for it and the first ordinance you ask for from the municipal assembly will fasten on you, by ordinance, what you had voluntarily given."

[2] See Chapter IV, Fig. 8; see also Report of Committee on Fares and Transfers, 1912 Proceedings of the *American Electric Railway Transportation and Traffic Association*, page 305.

[3] For further discussion, see Jewell — "Transfers — Their Uses and Abuses," 1904 Proceedings of the *American Street Railway Association*, page 271.

[4] For further discussion, see J. V. Sullivan — "Chicago's Transfer Crusade" — 1909 Proceedings of the *American Street and Interurban Transportation and Traffic Association*, page 265.

Report of Committee on Transfers and Transfer Information — 1910 Proceedings of the *American Street and Interurban Transportation and Traffic Association*, page 204.

L. S. Hoffman — "Transfer Laws and Suggested Changes" — 1910 Proceedings of the *American Street and Interurban Transportation and Traffic Association*, page 212.

Report of the Committee on Fares and Transfers:

1911 Proceedings of the *American Electric Railway Transportation and Traffic Association*, page 482.

1913 Proceedings of the *American Electric Railway Transportation and Traffic Association*, page 335.

1914 Proceedings of the *American Electric Railway Transportation and Traffic Association*, page 367.

business, the existence of which is a necessary condition of the flat rate of fare. The American system of flat rates calls for a large increase in the number of short rides to compensate for a small increase in the number of long ones and a material decrease in short riding must eventually result in increased fares for the longer trips. These two results, the decreased number of short rides and the increased number of longer rides, constitute the greatest difficulties growing out of the use of free transfers and must be borne in mind in considering any proposal to extend the use of transfers.[1]

The problem of cost involved in any contemplated increase in the transfer privilege may be stated as follows:

Certain changes in the transfer system are proposed. What will be the probable effect of their adoption on the net earnings of the company?

Net earnings are affected both by changes in revenues and by changes in expenses, and any factor influencing either should be examined. It will be observed that these tendencies will not be found to work independently. Such a change as will stimulate riding will be either a change to lower rates for the same service or a change to more service for the same rates. The first of these — lower rates for the same service — is a factor tending to decrease revenues as well as to stimulate riding. Similarly the necessary payment of an additional fare will have a tendency both to increase and decrease revenues.

It is not the purpose here to discuss the effect of rate of fare on riding habit, this matter being taken up in detail in Chapter XIX, nor to measure the relative weight to be given to the conflicting tendencies mentioned above. The problem as it presents itself here will be limited to the effect on net revenue through effect on cost, together with the effect on revenues of the elimination of certain fares, not through lessened riding but through the use of a fare and a transfer instead of two fares.

Any change in the existing transfer system should be scrutinized as to its possible influence on expenditures and it will immediately be apparent that such changes may be expected to occur in the following ways:

### Diversion of Traffic

This involves the entire problem of routing and its effect on the relation of seat miles to passenger miles. A company which can improve its load factor, that is, the ratio of facilities used to facilities furnished, by changing its transfer system, is not now employing the best routing, and should take steps to so route its cars that they will follow the flow of traffic. When this is done, the use of transfers

[1] "The Free Transfer Problem," F. W. Coburn, *Stone & Webster's Public Service Journal*, February, 1909, pages 77–85, quotes C. W. Weston as follows: "The average distance of haul determines whether the company as a business proposition lives or dies * * * if the average haul is less than the critical distance the company is prosperous; if greater, bankruptcy is inevitable."

will be confined to those passengers whose journeys are not typical of the movements of traffic in general. While it is possible that a change in transfer regulations will bring about an increased load factor, it is equally probable that there will be required additional car miles on certain sections of lines resulting in a decreased load factor. If not required at the time the change in the transfer system is effected, it is quite probable that additional service will be required at an earlier date than would otherwise be the case. It is not within the scope of this chapter to deal with the general problem of car routing, and while it will be assumed here that no change in the number of car miles furnished will follow an extension of transfer privileges, this assumption is by no means of universal application.

### Altered Possibility of Fraud

This must be considered entirely as a local problem. The system of collection and accounting of fares and transfers in effect will have an important bearing on the problem as will also local laws or ordinances and their enforcement. A discussion of these factors will not be undertaken here, but it may be stated that a company able to prevent misuse of transfers under one system is not likely to meet insuperable obstacles in protecting its interests if the system is changed in certain respects. It should be pointed out, however, that considerable additional expense may be incurred both in the printing of transfers and in their distribution, collection and accounting, in order to prevent misuse after changes are inaugurated. Any extension in privileges will be accompanied by increased opportunity for fraud and this is particularly true when transfers are issued on transfers. The cost of apprehension and prosecution of offenders, together with the cost of protective and preventive devices and measures, is a proper charge against the change and while it cannot be evaluated in a general discussion such as this, it is nonetheless not to be overlooked in any particular case.

### Change of Length and Number of Rides

These characteristics of traffic must be determined by observation and analysis of actual traffic movements, and while such studies present no great difficulties, they involve many processes which it is not necessary to detail here in view of their elaboration in Chapters VIII to X.

To illustrate the procedure suggested, application will be made to the typical urban property assumed in connection with the computations made in Chapter XIV. Table XCI is a condensed income account for this property, arranged according to the functional classification previously developed.

An examination having been made, it is found that the proposed extension of the transfer privileges will result in increasing the number of transfer passengers by 2 000 000. Fifty per cent of these

are now paying a cash fare for the second ride and the other 50 per cent are making one less transfer than they will under the more flexible system proposed. The effect of this is shown by a decrease in the number of revenue passengers to 39 000 000 and an increase in the total number of passengers to 55 000 000. The number of passenger miles will not be changed sufficiently to affect car miles and hence will have little effect on costs varying with car miles. The establishment of a number of additional transfer points will reduce the speed of cars and thus increase those costs that vary with car hours. There will also be some additional power costs arising from additional stops.

TABLE XCI — FUNCTIONAL INCOME ACCOUNT

| ITEM | Income account covering operation of all lines of the company | Number of functional units | Annual cost per unit | Number of functional units after adoption of proposed change | Income account of all lines after adoption of proposed change |
|---|---|---|---|---|---|
| Operating revenue | $2 000 000 | 40 000 000 | .0500 | 39 000 000 | $1 950 000 |
| Operating expenses (including replacement insurance) | 1 300 000 | .......... | ....... | .......... | 1 302 625 |
| Variable operating expenses related to: | 909 000 | .......... | ....... | .......... | 911 625 |
| Car miles | 254 600 | 7 000 000 | .0364 | 7 000 000 | 254 600 |
| Car hours | 7 200 | 750 000 | .0096 | 753 750 | 7 236 |
| Number of passengers | 65 400 | .......... | ....... | .......... | 66 328 |
| Passengers | 52 320 | 54 000 000 | .0097 | 55 000 000 | 53 289 |
| Passenger mile | 13 080 | 160 000 000 | .0008 | 159 500 000 | 13 039 |
| Cars handled | 51 000 | 290 000 | .1758 | 290 000 | 51 000 |
| Platform labor | 369 000 | .......... | ....... | .......... | 370 661 |
| Car hours | 332 100 | 750 000 | .4428 | 753 750 | 333 761 |
| Layover and guarantee | 36 900 | 145 000 | .2545 | 145 000 | 36 900 |
| Power | 161 800 | .......... | ....... | .......... | 161 800 |
| Car miles | 137 530 | 7 000 000 | .0196 | 7 000 000 | 137 530 |
| Standby costs | 24 270 | .......... | ....... | .......... | 24 270 |
| Fixed operating costs | 391 000 | .......... | ....... | .......... | 391 000 |
| Net operating revenues | 700 000 | .......... | ....... | .......... | 647 375 |
| Fixed charges (taxes and return) | 700 000 | .......... | ....... | .......... | 700 000 |
| Deficit | .......... | .......... | ....... | .......... | 52 625 |

No change in fixed operating costs or in fixed charges of any great magnitude is likely to occur. Sufficient slowing up of schedules might necessitate additional equipment of various kinds but these expenses, together with possible increases in power consumption will be neglected. The chief items to be considered are:

(1) A decrease of 2.5 per cent in revenue;
(2) An increase of 1 per cent in "passenger" costs;
(3) An increase of 0.5 per cent in car hour costs.

Applying these to the income account, it appears that the net revenue is decreased $52 625. This results in the reduction of the rate of return from 7.0 to 6.38 per cent.

It will be apparent from the above cost analyses that the difficulties involved relate principally to the determination of the changes in units of operation. These involve changes in passenger flow and frequently in the car routing and will affect costs varying with the number of passengers, the car mile, and the car hour, in addition to revenue, in varying degrees, dependent upon the extent and character of the changes proposed.

In the preceding discussion, attention has been confined to the results of enlarging the privileges of passengers in the matter of the use of transfers. It will be of interest, in conclusion, to note briefly the result of making a charge of one cent for a transfer, as disclosed by the records of the Cleveland Railway Company.

TABLE XCII — RELATION OF TRANSFER TO REVENUE PASSENGERS — THE CLEVELAND RAILWAY COMPANY

| PERIOD | 1913–1914 | | | 1914–1915 | | |
|---|---|---|---|---|---|---|
| | Passengers | | Transfer to revenue passengers | Passengers | | Transfer to revenue passengers |
| | Revenue | Transfer | | Revenue | Transfer | |
| | During this period no charge for transfers | | | During this period a one cent charge for transfers | | |
| | | | *Per cent* | | | *Per cent* |
| Sept.... | 19 007 265 | 7 497 660 | 39.45 | 18 808 947 | 7 233 283 | 38.46 |
| Oct..... | 19 510 172 | 7 697 302 | 39.45 | 19 660 965 | 7 379 481 | 37.53 |
| Nov.... | 17 513 512 | 6 540 551 | 37.35 | 18 368 860 | 6 681 319 | 36.37 |
| Dec..... | 19 482 379 | 7 323 843 | 37.59 | 19 253 558 | 6 817 511 | 35.41 |
| Jan..... | 18 873 654 | 7 369 908 | 39.05 | 18 486 280 | 6 793 057 | 36.75 |
| Feb..... | 17 095 000 | 6 743 237 | 39.45 | 17 103 001 | 6 332 786 | 37.03 |
| Mar.... | 19 159 231 | 7 692 535 | 40.15 | 19 590 704 | 7 327 044 | 37.40 |
| April.... | 19 375 956 | 7 848 241 | 40.51 | 19 460 358 | 7 278 774 | 37.40 |
| May.... | 20 526 614 | 8 647 746 | 42.13 | 20 438 431 | 7 906 869 | 38.69 |
| June.... | 19 744 345 | 8 522 701 | 43.17 | 20 532 399 | 7 893 278 | 38.44 |
| July.... | 20 312 546 | 9 042 062 | 44.51 | 20 905 889 | 8 045 571 | 38.48 |
| Aug.... | 19 884 058 | 8 674 435 | 43.63 | 20 757 573 | 8 029 796 | 38.68 |
| Total... | 230 484 732 | 93 600 221 | 40.61 | 233 366 965 | 87 718 769 | 37.59 |

Table XCII indicates that the charge reduced the percentage relation of transfer to revenue passengers from the mean value of 40.6 for the year ended August 31, 1914, to 37.6 for the year ended August 31, 1915. A number of changes due to the construction of lines occurred during this period.[1] The lines not in operation during the earlier period are now reporting something over 10 per cent of all transfers. Taking this into account, the reduction in use has amounted to about 14 per cent. From this it appears that a considerable number of people, when there is no charge for transfers, board a car and ride thereon but a short distance. The use of the cars by these

[1] The East 79th Street crosstown line was opened in May, 1914. The extension of the West 65th Street crosstown line was opened in the fall of 1914. The West 25th Street line was made a crosstown line in July, 1914. The Harvard-Dennison crosstown line was put in operation late in 1913.

patrons who, since the charge for transfers was inaugurated, have discovered that they could walk without difficulty, has adversely affected the service rendered to those patrons who travel longer distances, both as regards available space within the cars and speed.

Of greater significance is the financial result of making a charge for transfers, as indicated by Table XCIII. This shows that in the first year of such charges, the revenue from this source amounted to $730 000. This is equal to about one-eighth of the total operating expenses, or over 40 per cent of the total interest disbursements, and indicates clearly the magnitude of the transfer as a financial factor when valued at only one cent.

TABLE XCIII — RESULT OF CHARGING FOR TRANSFER.— THE CLEVELAND RAILWAY COMPANY

| | Cash and ticket fares | Revenue from sale of transfers | Total |
|---|---|---|---|
| 1914 | | | |
| September | $593 771.54 | $58 682.42 | $652 453.96 |
| October | 618 361.63 | 60 542.69 | 678 904.32 |
| November | 577 606.83 | 56 040.55 | 633 647.38 |
| December | 604 569.28 | 57 453.88 | 662 023.16 |
| 1915 | | | |
| January | 580 447.48 | 57 445.01 | 637 892.49 |
| February | 536 180.91 | 53 559.20 | 589 740.11 |
| March | 675 017.30 | 60 914.54 | 735 931.84 |
| April | 672 543.95 | 63 652.73 | 736 196.68 |
| May | 710 046.71 | 65 810.19 | 775 856.90 |
| June | 703 692.30 | 65 291.23 | 768 983.53 |
| July | 718 712.82 | 66 374.10 | 785 086.92 |
| August | 714 464.15 | 65 807.11 | 780 271.26 |
| Total | $7 705 414.90 | $731 573.65 | $8 436 988.55 |

# CHAPTER XVIII

## COST OF COMPETING FORMS OF TRANSPORTATION

Influence of Transportation on City Growth,—— Effect of Competing Transportation Agencies on Cost of Service,—— Forms of Transportation Developed in American Cities: Walking, Private Conveyance, Public Conveyance,—— Field of Competition as Limited by Cost to Individual, Cost to Community,—— Comparative Service and Costs of Jitney-bus and Street Railway.

The growth of cities has presented many problems of which perhaps none is more difficult of solution than that of intramural transportation. The possibility of continued growth of cities is dependent upon the solution of the transportation problem, and, without the progress of the art and the continued investment of additional capital, which have made possible the developments in transit facilities, the modern city could not have been built. A number of types of city transportation service have been developed which are in varying degrees competitive with the electric railway and it will be of interest to consider these from the standpoint of cost, both to the individual and to the community.

All traffic movements involve the sacrifice of time, money, energy, and comfort in varying degrees. Some valuation of these factors is necessary to determine the relative economy of the various forms of transportation. The expenditure of time may be considered as consisting of three parts — time walking, time waiting, time riding, and time may upon occasion be expressed in terms of money. The direct expenditure of money will consist either of fares paid in public conveyances or of costs of operation of privately owned vehicles. The expenditure of energy is difficult of measurement and will be considered in this study as applying only to walking. The comfort of an individual, as has been previously pointed out, cannot be definitely measured.[1] It is here taken to cover the effect of a number of factors, one of the most important of which is exposure to the weather. A motorcycle on good roads and in pleasant weather may be deemed more comfortable by a young man than a seat in an electric car. The converse would likely be true in stormy weather, or even in fair weather, were the rider an older man. There is an additional factor in determining the economy of various forms of transportation to the community. This is economy in the utilization of space on thoroughfares maintained by the community.

From the beginning of urban transportation there have been three general agencies in competition — walking, transportation by private conveyance, and transportation by public conveyance. Of these, walking alone has remained unchanged in form, though as an agency of transportation, it has become relatively less efficient. Increased

[1] Chapter XIII. Psychological Aspects of Street Railway Service.

distances and less pleasant conditions have both influenced the extent to which individuals walk. In deciding as to whether he will walk or ride, the individual weighs the expenditure of time and energy against the expenditure of money, and as the time saved by riding becomes greater, as inevitably occurs with the growth of cities, and the discomfort and expenditure of energy in walking increase, because of city congestion, the competition between walking and transportation by conveyance becomes steadily less. There will always remain in any city many short journeys which could be made by vehicle but which will continue to be made by walking. Here the fact that there is no wait necessary for the pedestrian is frequently of determining importance. It is a matter of common experience that many a journey is made on foot because there is no conveyance immediately available, although the time of the journey is considerably greater than would have been the case had the individual waited for an opportunity to ride.

The competition between walking and public and private means of conveyance could be elaborated at length as it presents many interesting phases of community habit and urban growth which bear a vital relation to the development of demand for transportation and its cost. It is sufficient for the present, however, to look more particularly at the characteristics of the various competing private and public agencies of transportation.

The early forms of public conveyances used for transportation purposes in American cities naturally followed the type of vehicle in private use and were in general, a modification of the English stage coach, adapted to American roads and operating conditions. They differed from private conveyances in that their movements were more or less organized and regular, and in that all able to pay the price were entitled to use them.[1] They had the same right of use of the public highways as private conveyances but because of their public nature came to be held to be common carriers.

The horse-drawn omnibus was later run on wooden rails and was then supplanted by the horse car, which in turn was enlarged and improved from time to time. As a result of constant attempts to furnish better and more efficient service, the horse car was in time succeeded by the cable car. This form of transportation proved to be merely a temporary expedient and was superseded by the electric street car.

These means of public transportation were confined to the street surface. In the larger cities the development has extended to elevated and subway lines. In 1868, for example, an elevated cable road was

[1] The first transportation of which there is any record, was inaugurated in 1732, and was in the form of a stage line operating between New York and Boston, which trip required a period of fourteen days and was made monthly. The next was that of hack service, which was started in New York in 1798. Stage coaches were subsequently started on Broadway, but it was not until 1830-1831 that this service assumed definite form. There were 120 carriages in service, and the general fare within the city was 12½c.; to Yorkville, 18¾c., and to Manhattanville and Harlem, 25c.— A Glance at New York, 1837.

built and placed in operation in New York City. From 1871 to 1902 this and other elevated lines in that city were operated by steam power, electrification taking place in the latter year. In 1904, the subway was placed in operation. The development of types of transit facilities in New York City has been more rapid and more extensive than elsewhere but the same general lines of development have occurred throughout the country. In each instance where improvements have been made, the older and less perfect form of transportation has continued in use for a time. Public demand for improved service, however, has been usually too insistent to permit the using up in operation of investment in early types of equipment, and the scrapping of serviceable property has added considerably to the costs of present day transportation.

Within recent years the number of private conveyances has been augmented by the invention and development of the bicycle, the motorcycle, and the automobile. There has also been added to the list of public conveyances the suburban steam train, the taxicab and the motor bus. This last form of conveyance was developed along two rather distinct lines — the large car with special body, and the small pleasure car devoted to, although not designed for, public use. This small motor car has become known as the "jitney" bus, from the fare charged, five cents.

It is our purpose to examine here the relative economy of certain of these transportation agencies, both from the standpoint of the community and that of the individual.

The matter of street congestion is one of great importance and many cities have expended large sums in widening existing streets and in constructing additional thoroughfares for the purpose of relieving traffic congestion. It is evident therefore, that one factor to be considered in comparing various forms of transportation is economy of street space. The steam road operating on a private right-of-way, the subway, and to a lesser extent, the elevated contribute very little to the congestion of streets. Of those facilities operating on the surface of streets, the electric railway is easily the most economical of space. Following this are the large motor cars and finally the small motor cars in public service and the various private means of conveyance. Many computations have been made as to the street width necessary to move in motor cars the number of people carried easily on a street railway car occupying not over eight feet in width, but without reproducing the details of such calculations, it is evident that the motor car is very wasteful of street space.

Cities regularly spend large amounts of money on constructing and maintaining paving and in cleaning and sprinkling streets. Street railways are frequently required to pave and maintain the roadway in the track zone, and to sprinkle the street and to remove the snow from a considerable portion. This interesting situation occurs despite

the fact that the street railway does not use paving itself but actually provides a means whereby others avoid such use. Obviously then as a user of space and as a contributor to operation and maintenance of the highway the street railway is the most economical surface transportation agency when viewed from the standpoint of the community.

In the matter of taxes, it is possible to distinguish between private vehicles and public carriers, but no general scheme of taxation has been worked out which, when applied to the several types of public conveyance, permits an equitable distribution of the tax burden between their patrons. Under the present systems of taxation, however, street railways are large contributors to the common funds through special franchise taxes, in addition to the customary general property taxes. As a tax contributor the street railway compares favorably with private vehicles and certain other forms of public carriers.

From the standpoint of the individual rather than of the community, an examination of the relative economy of competing forms of transportation will proceed along somewhat different lines. As has been pointed out in an earlier paragraph, there are several factors which measure the individual's preference for one of the competing forms of transportation. These are the rate of fare and speed, which can be definitely measured, and the ease and comfort of the means of travel which are important factors but difficult of measurement.

Undoubtedly, the most comfortable and convenient as well as the most rapid form of urban transportation devised is that offered by the better class of privately owned automobiles. Following this, but at a considerable distance in the scale of comfort and convenience, is the taxicab. Under certain conditions, horse cabs are desirable but they are slower and in general do not furnish to the passenger as great protection from the weather as do the motor cabs. One of the chief advantages of private cars and taxicabs is that they are not restricted to any pre-arranged route and that they furnish a high degree of privacy. The large motor bus does not have this advantage of flexibility and privacy, nor on the other hand does it furnish any great degree of comfort or speed. The small buses or "jitneys," undertaking to carry passengers short distances for five cents, furnish at times of light traffic and during pleasant weather, a somewhat more comfortable ride than is furnished by electric railways, but the service is limited and frequently unreliable. The service of steam roads in suburban territory is rapid but relatively infrequent and stations or stops are a considerable distance apart. As to the indefinite elements of service, convenience, comfort, etc., there is no great difference between steam roads, subway and elevated lines, and surface lines. The latter are, however, less economical of time for journeys of any considerable distance.

In the matter of cost, the electric railway is easily the most economical transportation agency operating in cities while the large private

automobile is the most expensive. Elevated and subway lines are economically operated but their great first cost makes them possible only in regions of very great traffic density. Suburban passenger service furnished by steam roads is very generally unprofitable business, if it is made to bear its fair share of the costs arising out of the expensive terminals involved. If, however, the cost of this service is taken to be simply the additional costs occasioned by its existence, it may be found to be profitable for a temporary period or until such time as the other business of the railroad demands the use of the facilities temporarily devoted to suburban passenger service. With a wide variety of types of rates but with a tendency toward higher fares for distances of less than ten miles, the steam road is not ordinarily a competitor of the urban electric railway.

From the standpoint of cost, there has developed but one competitor of the electric railway, the "jitney" bus, and this is a competitor for a part only of the traffic — that moving two miles or less. There have been pointed out previously some of the disadvantages of this means of transportation from the community standpoint, in that it is prodigal of street space and does not contribute to as great an extent as the street railway to the maintenance of streets and to the community funds. It will be in order next to see what service the "jitney" can render the individual patron for five cents.

It is now generally recognized that competition between public utilties results in an economic waste without improved service, and that public utilities are best conducted as regulated monopolies.[1] The effect of such regulation upon the costs of operation of electric railways has already been shown in previous chapters and it is likely that with the growth in regulation of the jitney bus a similar effect upon its costs of operation will be observed.[2]

It will serve convenience and facilitate comparisons to examine the various elements of the cost of operation of "jitney" buses under the general groups of accounts in use by electric railways.[3]

*Maintenance of Way and Structures.* Under this head there will be normally little expense for the man who operates his own car. Companies, however, which maintain their own garages or own and maintain general office buildings will incur expenses properly listed as Maintenance of Buildings, Fixtures and Grounds, and as Depreciation of Structures. Inasmuch as the greater part of the operators

---

[1] The Georgia Railroad Commission in Georgia Railway and Power Company vs. Jitney Bus Co. et al (P. U. R., 1915, C page 928), found as follows: "The regulation of jitneys operating in competition with street cars is essential in order that the Commission may fairly, justly and intelligently regulate the street railroad company's business and intelligently decide whether its service is adequate."

[2] Regulation of the jitney bus has so far taken the form of licensing drivers, fixing routes and rates, and providing for indemnity bonds. For further discussion see: Report of the Bureau of Fare Research of the American Electric Railway Association, Cost of Service of the Jitney Bus; King, C. L., A Digest of Ordinances Regulating Jitney Buses adopted in American Cities. *The Utilities Magazine*, (July, 1915), page 28.

[3] The following discussion of costs is taken with slight changes from an article by the author, entitled "The Economics of Jitney Bus Opeiation", *Journal of Political Economy*, July 1915.

of "jitneys" own their cars and keep them in sheds and stables not otherwise in use, no cost has been considered under this head. Individual "jitney" owners are under no necessity of counting as part of the cost of operation, taxes, interest on the investment in, and the cost of maintenance of, property otherwise idle. Such items have, however, been considered in part under the caption of garage costs.

*Maintenance of Equipment.* Some rather extensive cost figures have been kept during the past year by a company which is a member of the American Electric Railway Association. This company operates several types of cars in different cities, and its records based on 20 Ford cars in service for eight months disclose an expense of 1.3 cents per mile for maintenance of chassis and body. Tires cost 1.2 cents per car mile, and miscellaneous expenses for maintenance and replacement of parts amount to 0.8 cents per car mile, or a total for the three items of 3.3 cents. These costs do not allow for depreciation and replacement of the car. Figures for these three items from two other reliable sources and covering other types of cars are 7.71 and 4.56 cents per car mile.

*Power.* Under this heading there must be included the cost of gasoline and oil, and engine maintenance. For the Ford cars above referred to, the cost for those items was slightly over 2.5 cents per car mile, while the amounts for the other two types of cars, were 4.43 and 2.39 cents per car mile, respectively.

*Conducting Transportation.* Under this heading there will be included the wage of the driver besides certain charges such as cost of tickets, cost of gas or oil for lighting, and cost of signs on cars. The figures which the Bureau of Fare Research has been able to obtain for this item show a wide variation. One jitney company pays 2 cents per mile; one 30 cents per hour; another pays $8 per week to foreigners for this type of work. Still another company is reported as paying $15 per week, and one pays the driver 35 per cent of the gross receipts. Inasmuch as the possession of a license is necessary in many cities if one wishes to operate a car, it seems that the minimum wage which can be paid will not be greatly below $2 per day. It is reasonable to suppose that it is not economical to attempt jitney operation with less skilled employes than those who can command $2 per day. The man who drives his own car may donate his time to the business and count as profit his net revenue. This is not likely to be the general practice, however, and we may safely assume that the owner-operator will consider his time worth at least $2 per day.

During times when employment is scarce and labor is plenty, a wage less than $2 a day may be paid, particularly in the case of men and boys operating cars for three or four hours per day in

addition to some other occupation. There is reason to believe, however, that if the jitney bus should achieve permanence in any community, it would meet labor conditions approaching those on electric railways. It is the common experience in industry that low wages and long hours are succeeded, as the industry becomes established, by shorter hours and higher wages. Certainly there would be, in the case of jitney operation, a tendency toward standardization, and $2 per day appears to be a reasonable estimate.

*Traffic.* There will usually be little to be considered under this heading. An occasional payment for advertising and solicitation may occur, but this in general may be neglected and may to a certain extent be offset by revenue from advertising.

*General and Miscellaneous.* Injuries and damages and insurance will be the most important items in this group and will in many instances be by far the largest expenses to be met by the owner-operator.

In Cincinnati, the Baltimore and Ohio System found that 3.4 per cent of the teamsters and 5 per cent of the pedestrians complied with the admonition to stop, look, and listen, while out of the 184 drivers of motor vehicles none took proper precautions.

Carelessness in the operation of motor vehicles is emphasized in a report of the Safety Bureau of the El Paso & Southwestern Railroad. Three thousand six hundred and seven automobiles were observed crossing railroad tracks in El Paso in one week. Of the drivers of these, 2907, or 80 per cent, looked in neither direction, 620, or 17 per cent, looked in one direction only, and 80, or 2 per cent, looked both ways before crossing. Of the 2907 who took no precautions, over 10 per cent crossed at a speed above 20 miles per hour.

Of general interest in this connection is the statistical information concerning deaths and injuries occurring in the public highways, compiled by the National Highways Protective Association. These figures refer only to pedestrians knocked down or run over, or to occupants of vehicles killed or injured, but not themselves participants in the blame for the accident. These statistics indicate very clearly the danger to pedestrians from motor vehicles.

The accompanying table gives the fatalities in New York City, and in New York State excluding New York City, for several years.

NEW YORK CITY

| Type of vehicle | 1910 | 1911 | 1912 | 1913 |
|---|---|---|---|---|
| Automobile | 112 | 142 | 221 | 302 |
| Electric railway | 148 | 109 | 134 | 108 |
| Wagon | 211 | 172 | 177 | 170 |

NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY

| Type of vehicle | 1910 | 1911 | 1912 | 1913 |
|---|---|---|---|---|
| Automobile | ...... | 132 | 127 | 149 |
| Electric railway | ...... | 67 | 79 | 79 |
| Wagon | ...... | 31 | 28 | 32 |

The greater danger to pedestrians from motor vehicles arises from inherent qualities of these vehicles. They run rapidly, quietly, and depart from a fixed path at the will of the driver, turning into side streets and coming from behind other vehicles with confusing quickness. They are not all driven by men trained to their work and freed from distraction in the performance of it. Many observations made on the care exercised at railroad crossings put automobile drivers at the bottom of the list.

The rates for insurance indemnifying automobile operators against loss through injury and damage suits are not as yet based upon sufficient experience to render them stable, and, where jitney buses have become numerous, they have been increased.

In one of the Pacific coast cities, each of the three bonding companies there represented has, since the advent of the jitney bus, refused to issue indemnity insurance for such vehicles, and in another city, somewhat smaller, the rates for such policies have been increased from an annual fee of $50.00 to one of $250.00.

A policy indemnifying the holder against loss through personal injury claims to the amount of $5,000 for any one person, and $10,000 for any one accident may be obtained for $200 per year in the case of cars seating less than 12 passengers and operated for hire.

To this sum should be added insurance against damage from fire, against damage from collisions, against loss by theft, and against judgments obtained by employes. The rates for these kinds of protection vary, and while the owner-operator will not need protection against his liability as an employer, some life or accident insurance may be considered a good investment. Approximately these risks can be pooled through insurance for $200.00 to $300.00 per year.

Garage expense, cleaning, and inspection may be figured at from $12.00 to $20.00 per week. This expense will be avoided by owner-operators of single cars, but is nevertheless a real outlay which must be taken into account where several jitneys are operated by employes.

*Fixed Charges.* In addition to ordinary operating expenses, the items of depreciation and interest are essential parts of the cost of service.

By far the largest number of jitney buses in service are Ford five-passenger touring cars. These require a minimum investment and ap-

pear to be as cheaply operated as any cars of their capacity. A new car of this type costs about $500.00 at Detroit, and the profit-sharing dividends of this company care for a little more than the freight on the average car put into this service. The private user receives an allowance on an old car turned in on the purchase of a new one which is based on an estimated normal use of 5 000 miles for one year. The depreciation to be charged for one year's use is the difference between the cost of a new car and the allowance for a car one year old. This difference is approximately $200.00 at the present time, and, although price changes may alter this amount, there will doubtless be a gradual adjustment by the manufacturer of both the cost of a new car and the allowance for an old car which will tend to keep this figure reasonably constant.

It should be noted that $200.00 is the minimum depreciation and depends upon the condition of tires, engine, etc., and of course assumes that the car has met with no accident. It is based, as stated above, on an estimated normal yearly operation of 5 000 miles. For two years' operation, or 10 000 miles, the minimum depreciation is about $275.00. It appears that operating costs are somewhat higher during the second year, although probably not enough to account entirely for the fact that many companies operating a considerable number of cars turn them in each year toward new cars. There seems little reason to doubt that, considering the excess of mileage over 5 000 made yearly by the "jitney," the minimum depreciation, whether new cars are secured each year or on alternate years, will be $200.00.

The interest on the purchase price at 8 per cent is $40.00 per year and the annual cost of maintaining the investment is taken to be $240.00. Similar figures furnished by individual owners of private cars range from $160.00 to $225.00. These figures seem to confirm the reasonableness of the estimate of $240.00 for a car in public service.

The items of taxes and license fees may be considered together. The minimum license fee for state registration is in most cases $5.00. In addition to this expense the automobile will in many states be taxed as personal property, and, while tax rates vary greatly, $5.00 is probably a minimum amount to be estimated for this item of cost. In many communities a license is now required to operate a public bus or hack. There is no uniformity of license fees, and no estimate can be made as to the amount of the average fee.

Table XCIV summarizes the figures previously referred to in detail.

Collecting the figures shown above and putting most reliance on those coming from companies which keep cost data, a tentative summary of costs may be made. This involves first the recognition of two classes of competing vehicles, those really transient in character which are devoted to the "jitney" service from time to time by their owners, who are also the operators, and the cars owned by an

individual or corporation and devoted seriously to the business. These will be operated by paid drivers.

TABLE XCIV — OPERATING EXPENSES

| Item | Typical jitney cars | |
|---|---|---|
| | Cents per car mile | Dollars per year |
| **Way and Structures** | ......... | ......... |
| **Equipment** | 4.56–7.71 | ......... |
| Car body and chassis | 2.1 | ......... |
| Tires | 1.2 | ......... |
| **Power** | 2.39–4.43 | ......... |
| Engine | ......... | ......... |
| Gasoline | ......... | ......... |
| Lubricants | ......... | ......... |
| **Conducting transportation:** | | |
| Drivers | 2.0 | 416–832 |
| Garage expense | ......... | ......... |
| Traffic | ......... | ......... |
| **General and miscellaneous:** | | |
| Supervision and office expense | ......... | ......... |
| Injuries and damages | ......... | 75–150 |
| Insurance | ......... | 50–150 |

The first class of operators will not feel the necessity of making the service bear all the elements of cost which it should, treating the matter as a casual occupation and charging against it additional costs only. These men are put to no extra expense for housing their cars and consequently will not feel that any part of the fares collected from passengers should go for this purpose before profits are computed. A similar view will doubtless be held of taxes, interest, and depreciation.

Looking at the matter from the point of view of these men, the "cost" of operation is simply the expenditure for gasoline, oil, repairs, and tires, and the difference between this amount and the fares collected represents profits. The lowest reliable figure reported for these items is 5.8 cents per mile. Assuming a 2.5 mile route (round trip 5 miles) and 100 miles as a day's run, $5.80 represents the "out-of-pocket" cost. If four passengers are hauled on each trip the fares will amount to 40 cents per round trip or $8.00 per day, leaving a wage for the operator of $2.20. A shorter haul or a higher number of passengers will increase the operator's wage, but it is not likely that much more profitable conditions than those assumed can be regularly found.

Considering now the case of the company which purchases machines for the service and treats the whole matter as a business proposition, allowing for all the elements of cost, we reach a somewhat different conclusion.

The costs varying with the mileage made will be placed at the figure used above, 5.8 cents per mile. Other operating expenses to be considered are insurance of all kinds, including injuries and damages, $200.00 per year; cleaning, inspection, and housing, 30 cents per day, say $100.00 per year; wages of driver, a minimum of $2.00 per day, or $700.00 per year; superintendence and management, 0.75 cent per mile, or, on the basis of 75 miles per day for 350 days per year, $195.00 per year. This figure is based on the expenses of supervision of one of the largest taxicab companies and probably could not be equaled by a company operating less than 300 cars.

The foregoing operating expenses may be summarized at 5.8 cents per car mile plus $1195.00 per year. To these must be added $240.00 interest and depreciation, and, for want of better information, $5.00 each for state registration, personal property tax, and public vehicle license. The total then is $1450.00 per year plus 5.8 cents per car mile. This includes an 8 per cent return on investment in cars. Thus excluding return and reducing the amount to a per day basis (350 days to the year), the cost is found to be $4.05 per day plus 5.8 cents per mile. The depreciation is based on 5000 miles per year and would likely be exceeded, inasmuch as 75 miles per day or 25 000 miles per year will probably be run. The depreciation estimate of the Ford Company is $200.00 for 5 000 miles or 4 cents per mile. The foregoing assumption reduces the rate to 0.8 cent per mile but, as stated above, the item will be handled as a yearly lump sum of $200.

Allowing no return on investment, the relation between the number of passengers per half round trip and the maximum length of half round trip for vvarious daily mileages is shown in Table XCV.

Table XCV — Length of Half Round Trip in Miles

| Number of passengers per half round trip | 75 miles per day | 100 miles per day | 150 miles per day | 200 miles per day |
|---|---|---|---|---|
| 1 | 0.45 | 0.51 | 0.58 | 0.63 |
| 2 | 0.89 | 1.02 | 1.17 | 1.27 |
| 3 | 1.34 | 1.52 | 1.76 | 1.91 |
| 4 | 1.79 | 2.04 | 2.34 | 2.55 |
| 5 | 2.24 | 2.64 | 2.83 | 3.18 |
| 6 | 2.68 | 3.05 | 3.52 | 3.82 |

It will be observed that the maximum length of route, for an average of four fares per half round trip and an average of 150 car miles per day, is about 2.3 miles, and should the jitney be required to contribute to the public funds in the same proportion as certain street railways the distance would be reduced to 1.94 miles; or if paving obligations were eliminated and taxes only were made proportional, that is, at 6.75 per cent of gross revenues, the maximum length of route would be 2.19 miles.

It is of considerable interest to compare the costs of transportation by the small automobile with the costs on a typical electric street railway.

TABLE XCVI — CONDENSED INCOME ACCOUNT COVERING ONE YEAR'S OPERATION (STREET RAILWAY)

| Item | Amount | Number of units | Cost per unit |
|---|---|---|---|
| Operating revenue (total) | $5,053,000 | .......... | .......... |
| Cost of service (total) | 5,053,000 | .......... | .......... |
| (a) Costs varying with car hour | 934,750 | 1,825,000 | 51.21c |
| (b) Costs varying with car mile | 774,325 | 16,242,500 | 4.77c |
| (c) Costs varying with mile of single track | 372,204 | 350 | $1,063.00 |
| (d) Costs varying with number of passengers | 122,174 | 90,000,000 | .13c |
| (e) Costs of electrical energy (car mile) | 365,863 | 16,242,500 | 2.25c |
| (f) Administrative and overhead expense burden | 883,684 | % items (a) to (e) inc. | 34.4% |
| (g) Return upon investment | 1,600,000 | .......... | .......... |

Table XCVI is a condensed income account covering one year's operation of the typical company assumed in Chapter XVI, Cost of Complying with Service Standards. Applying the cost methods outlined and discussed in Chapter XIV, The Paying Haul — Cost of Extending Fare Limits and Lines, it is determined that the costs of operation are 56.6 cents per half round trip, plus 17.16 cents per car mile. These figures are based on service which will show a load factor of 55 per cent or in the case assumed, of 22 passengers per half round trip. If the service is made more frequent by proportional additions at all periods of the day so that the concentration remains unchanged, until the average number of passengers per half round trip is 15, the costs become 38.6 cents per half round trip, plus 17.16 cents per car mile. Similarly, a reduction in service to a point where the average number of passengers per half round trip is 30 will be accompanied by costs of 77.2 cents per half round trip plus 17.16 cents per car mile;

TABLE XCVII — COST PER PASSENGER — CENTS

| Miles per half round trip | Number of passengers per half round trip | | | |
|---|---|---|---|---|
| | 15 | 22 | 30 | 40 |
| 1 | 3.72 | 3.35 | 3.15 | 3.00 |
| 2 | 4.86 | 4.13 | 3.72 | 3.43 |
| 3 | 6.00 | 4.91 | 4.29 | 3.86 |
| 4 | 7.15 | 5.69 | 4.86 | 4.29 |
| 5 | 8.29 | 6.47 | 5.43 | 4.71 |
| 10 | 14.01 | 10.37 | 8.29 | 6.86 |

and 40 passengers per half round trip will be accompanied by costs of 102.92 cents per half round trip plus 17.16 cents per car mile.

These results may be arranged in detail as shown in Table XCVII.

For purposes of comparison with the jitney bus, the costs may be expressed in miles per five-cent fare.

TABLE XCVIII — MILES FOR FIVE-CENT FARE

| Passengers per half round trip | Miles for 5-cent fare |
|---|---|
| 15 | 2.21 |
| 22 | 3.11 |
| 30 | 4.24 |
| 40 | 5.67 |

It is of interest to note in comparison with costs of jitney bus operation that, with the length of haul of two miles, which is about all the jitney bus can do for a nickel (with an average of four passengers per half round trip) the electric railway would require under normal conditions of operation about 15 passengers per half round trip to make operation profitable at 5 cents per passenger. A car with 20 passengers can be run on such a route and schedule as this for a 3.5 cent fare. A passenger riding 10 miles, however, in a car which is carrying on the average 20 people per half round trip would have to pay something over 10 cents per ride to cover the cost of his transportation. We may assume, for example, four lines, respectively, 2, 3, 5 and 10 miles in length, with the same fare of 5 cents and that 3000 people ride on each line during 100 half round trips. A fare based on cost for all trips would yield the railway $651.90, while the flat-rate 5-cent fare would yield $600.00 as indicated in Table XCIX.

TABLE XCIX — EFFECT ON RATES OF LOSS OF SHORT TRIP BUSINESS

| Length of half round trip (Miles) | Number of passengers | | Receipts on cost basis | | Receipts on flat rate basis | |
|---|---|---|---|---|---|---|
| | Per half round trip | Total | Per passenger | Total | Per passenger | Total |
| | | | (*Cents*) | | (*Cents*) | |
| 2 | 30 | 3,000 | 3.72 | $111 60 | 5.0 | $150 |
| 3 | 30 | 3,000 | 4.29 | 128 70 | 5.0 | 150 |
| 5 | 30 | 3,000 | 5.43 | 162 90 | 5.0 | 150 |
| 10 | 30 | 3,000 | 8.29 | 248 70 | 5.0 | 150 |
| Total | ...... | 12,000 | 5.43 | $651 90 | 5.0 | 600 |
| Total, excluding 2 mile line | ...... | 9,000 | 6.00 | $540 30 | 5.0 | 450 |
| Total, excluding 2 and 3 mile lines | ...... | 6,000 | 6.86 | 411 60 | 5.0 | 300 |
| Total, excluding 2–3 and 5 mile lines | ...... | 3,000 | 8.29 | 248 70 | 5.0 | 150 |

The elimination of the 2-mile trip would clearly require that 6 cents be made the flat rate for the remaining lines; and the elimination of the 3 and 5 mile lines would raise this flat rate first to 7 cents and then to 8 cents.

It is evident then that the jitney bus can compete with the electric railway in the matter of the cost of operation only under very special conditions.[1] It should be borne in mind that each passenger now

---

[1] The following paragraphs are taken from the results of an investigation made by the Bureau of Fare Research in February, 1915. Though based on somewhat different assumptions and reached by a different process, the conclusions are substantially the same:

> If the "jitney" service survives the experimental stage and finds, as it may, that after being put by laws and ordinances into its proper relation to the community, passengers can be carried from a mile to two miles for five cents, this short haul competition will constitute the necessity for, and furnish a valid argument for, a much more serious consideration of the zone system of fares on the part of the electric railways and regulatory bodies than has been given it in the past. It is obvious that, to the extent that the street railways are deprived of the traffic that costs less than five cents per passenger to handle, they cannot continue to carry passengers for five cents where the cost is more than five cents.
>
> Insofar as rush-hour traffic is concerned, it is frequently found that the extra cars put into service for one or two hours a day are operated at a loss. If the development of "jitney" service would serve to reduce the concentration of traffic during rush-hours and thus permit the use of plant and equipment more efficiently and each unit more hours per day it would be a contribution of some economic value to the solution of the transportation problem. There seems little probability of this, however, because rush-hour traffic is not short haul traffic, and because with the "jitney" as with the electric railway, concentration of service into a few hours is expensive.

Referring to costs of electric railway operation:

> Figure II shows the relation between the four quantities, namely, length of half round trip in miles, rush hour headway in minutes, average number of passengers per half round trip, and fare in cents. In using this diagram, the figures on the outside of the two extreme vertical lines should be considered together and the figures on the inside of these lines should be considered together. For example, it is desired to find out how many passengers per half round trip it is necessary to carry in order to make profitable the operation of a line three miles long on which the fare is five cents, when the minimum headway during the rush-hour is two minutes. Placing the straight edge on the figure connecting three miles, column *L* and two minutes, column *S*, the point A on line *B* is determined. Connecting *A* and five cents, column *R*, 18 is read in column *P* as the number of passengers per half round trip.

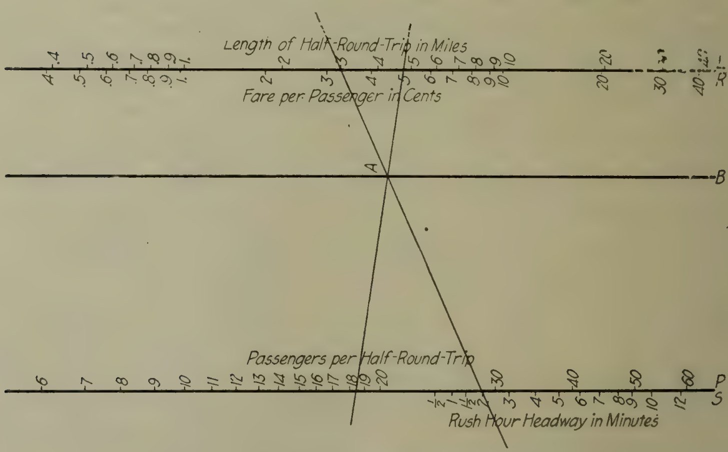



Fig. II. — Costs of Electric Railway Operation

riding two miles on an electric car contributes something toward the cost of carrying the passenger who rides 10 miles. If the jitney bus, then, is permitted to compete with electric lines for this short-haul business, it is obviously but a step toward the zone system of fares on the street railways.

From the preceding discussion of the characteristics of various forms of urban transportation, it is evident that the advantages and disadvantages of each type cannot be reduced to a common scale of measurement and directly compared. It is possible, however, to reach some conclusion as to the conditions of operation under which each form of transportation is of greatest value.

Walking is the most general form of urban transportation. It is limited, however, to short distances by the elements of fatigue and time, and is further limited by weather conditions. The accident hazard is low. Of the supplementary means of conveyance, the bicycle and motorcycle permit of greater speed than walking and have a far greater range. Their use is, however, limited by weather, roads, and by the physical vigor of the user. Their accident hazard is usually high.

Of the motor vehicles, the private car renders the most satisfactory service. It has a practically unlimited range of operation, is available when and where the owner desires, is rapid and comfortable. However, its initial cost and cost of operation make it an unobtainable luxury to the great majority, while at the same time it is extremely uneconomical of street space. Moreover, its operation is accompanied by a far greater accident hazard than is found in connection with other means of transportation. What is true of the private car is largely true of the public taxicab. The cost for occasional use is not as great as that arising from the ownership of a car, but for any considerable use this advantage disappears. The taxicab is also in general less comfortable and less easily available than the private automobile. In cost of operation the motor bus is limited to a restricted area if it attempts to operate at a five-cent fare. It is unreliable as a common carrier unless operating under prescribed standards. It is more or less affected by climatic disturbances and in northern latitudes severe snowstorms may often cause complete suspension of service with consequent great inconvenience to patrons. In common with other motor vehicles, the "jitney" bus is uneconomical of street space, contributing to congestion of traffic, and its accident hazard is high. It requires, moreover, a smooth and substantial street surface and at the same time exercises a destructive action upon the street paving, while in most cases making no contribution toward its maintenance.

In the previous discussion, it has been shown that from the point of view of cost, the street railway is the most advantageous of the public means of conveyance. The street car is most economical of

street space. It has no injurious effect on paving while frequently contributing to the cost of construction, and paying a large part of the cost of maintenance and cleaning. Its economical range is greater than that of the jitney and it lends itself better to systematized service. It operates on a definite schedule, over a fixed route and is practically independent of weather. These factors free the use of the electric railway from much of the uncertainty attached to the use of other means of conveyance. Reliability and immediate availability operate to offset to a considerable extent the advantages of greater speed which other vehicles possess under favorable conditions.[1]

Within recent years there has been much discussion of city planning. Looking back upon the growth of American cities, architects and engineers have pointed out defects of development in the absence of a definite policy of expansion, which have resulted in untold loss of time, money and comfort. It is possible to ameliorate much of this condition by an intelligent city transportation policy which coördinates what are now competing forms of transportation, with a resulting lower cost to the individual in sacrifice of time and money, and economy to the community in the operation of public highways. Suitable promenades for pedestrians, definite routes for motor trucks, speedways for automobiles and a cleared right-of-way for the street car with intelligent traffic rules well enforced, may do much to bring order and economy out of the chaos and duplication of facilities which are so common in American cities.

---

[1] Under some conditions the automobile shows little or no advantage in speed over the electric street railway car.

The following paragraph quoted from a report by City Chamberlain Bruere to Mayo, Mitchell (New York, N. Y.) on the question of establishing a municipal garage, (Oct. 6 1915) is in point:

> * * * The average mileage for a vehicle during the period in question was 2,654, or 28.4 miles a day. The average assigned time per day for a vehicle was 4.7 hours; the average rate of travel, including all stops, being 6.04 miles per hour. This low rate of travel indicates that it is decidedly uneconomical to use automobiles in any part of the city that is reasonably well provided with public service transportation facilities, since it not only costs much more per mile, but saves little or no time.

# CHAPTER XIX

## EFFECT OF RATE OF FARE ON RIDING HABIT

Public Interest in Rate of Fare,—— Purposes of Studies of Riding Habit,—— Factors Affecting Riding Habit: Facilities, Topographical Conditions, Climatic Conditions, Temperamental Characteristics, Competitive Facilities, Special Conditions,—— Experience of Various Cities,—— Increase in Riding Habit with Increase in Population,—— Technical Notes on Statistical Processes to Determine Degree of Correlation of Riding Habit and Rate of Fare.

The one feature of the electric railway business which is possible of precise measurement by the patrons is the rate of fare. The passenger has difficulty in estimating the headway between cars, their speed, the percentage of vacant seats or standing passengers, the temperature of the cars and the distance travelled. In fact, most, if not all, the characteristics of the service purchased are beyond the ability of the purchaser to measure.[1] The fare, however, is definite in amount and because of constant use of money in other ways, the patron is able to relate the price of transportation to the price of other things purchased. It is natural, therefore, that the rate of fare should be the subject of much attention.

There is a well-established principle of merchandizing that within certain limits sales increase as prices fall, and decrease as prices rise. This applies generally to luxuries, the sale of necessities fluctuating much less widely with price changes. In the case of certain articles which are commonly termed necessities, it should be observed that substitutes are available and therefore while supplying a need which must be met, the articles are not, in themselves, necessary and hence the extent of their sale does increase as prices fall by virtue of their more favorable position with respect to competing articles.

The assertion is frequently made that a decrease in fare will stimulate riding habit or the number of rides per capita of population per annum, and that this stimulus will go far to offset reductions in revenues from lower unit fares. The assertion is also made that riding habit increases at a greater rate than increase in population and based upon this assumption many extravagant predictions are frequently made as to what the future will have in store for the industry. The purpose of the present study is to examine the facts underlying these theories.

The study, it should be noted, is one of revenues and not of costs. Increases in gross receipts are not accompanied by corresponding increases in net earnings. In fact, it is very apparent from the preceding studies of the cost of extension of fare limits and lines and

[1] Chapter XIII, "Psychological Aspects of Street Railway Service."

the cost of extension of service,[1] that added increments of business are frequently more costly than all the revenues that can be possibly derived therefrom.

On a certain line, there are — let us say — 4 000 patrons per day at a five-cent rate and upon the reduction of the fare to four cents, the number of rides is increased to 5 000 per day. This, it will be observed, is a 20 per cent decrease in rate of fare and a 25 per cent increase in riding habit, a somewhat larger effect on riding than is usually claimed for a change in rates of fare. In this case, the revenues are unchanged but obviously the company is the loser by the difference between the cost of transporting 5 000 passengers and that of transporting 4 000 passengers.

Street railway transportation is used largely by patrons who have no other way of making their necessary journeys from point to point within the city. A large majority of these are the riders who go to and from their regular places of occupation and they will ride neither more nor less if fares are changed. Eliminating from consideration the pleasure seekers and the casual riders who form an inconsiderable part of the whole traffic, additional rides must be obtained from those now walking and riders using competing forms of transportation. Those who now walk and who would find it convenient to ride at a lower fare are those whose movements are parallel to a car line and for short distances. To these, the amount of time saved by riding as compared with walking, will not be great. The cheapest competitive form of transportation, as has been pointed out in a previous chapter,[2] is so much more expensive than electric railway transportation that no ordinary increase in rate of fare on the part of the electric railways will cause passengers to make use of it. From these preliminary considerations, it would appear that no great change in riding habit may be expected to follow minor variations in the rate of fare.

A number of changes in rates of fare have been made during the past 15 years in various American cities, and it will be of interest to examine the change in riding habit following such changes in fare. It has frequently been proposed to determine the effect of fare on riding habit by comparisons between cities in which different rates of fare are charged. It must be evident, however, that there are a large number of factors influencing riding habit and that it is not safe to conclude that differences in riding habit are primarily due to the differences in rates of fare. This is the more obvious when it is found, as is the case, that there is a considerable variation in riding habit between cities which have precisely the same fare.[3]

The factors which must be considered if any comparison is to be made between various cities may be enumerated under suitable headings as follows:

---

[1] Chapter XIV, "The Paying Haul — Cost of Extending Fare Limits and Lines," and Chapter XVI, 'Cost of Complying with Standards of Service."

[2] Chapter XVIII, "The Cost of Competing Forms of Transportation."

[3] Hild, F. W., "Rate of Fare and Riding Habit," AERA, March, 1914; also discussion by Nash, L. R., Stearns, R. B. and Coates, F. R.

### Facilities

The speed and frequency of electric cars and the number and location of car lines affect the extent of riding in small cities. Ordinarily a part only of a single traffic movement is made on the electric car. The individual leaves his place of residence, for example, to go to his place of business. The steps in this journey are as follows:

(*a*) Walk to car line,
(*b*) Wait for car,
(*c*) Journey in car,
(*d*) Walk from car line to point of destination.

For the majority of patrons, the only alternative is to walk from point of origin to point of destination. If the distance from the point of origin to the car line and from the car line to the point of destination is great and if the length of ride on the car is relatively small it may be that the time saved by using the electric car to complete the trip will be small and therefore the prospective passenger will weigh in his mind the relative advantage of the saving of a fare and the saving of a small amount of time.

It is evident then that in communities where the average length of ride is small, it is important that the location of the lines with reference to the origin and destination of the principle traffic movements be known as well as the speed and frequency of cars in order that two cities may be compared as to facilities for transportation.

### Topographical Conditions

Similar to the factors just mentioned, but worthy of separate treatment, are the physical conditions which make electric railway transportation appear more or less desirable. A city in which there are hills or a city in which the residence and business districts are separated by bodies of water and by the customary wholesale and shipping districts which lie along bodies of water, will show a considerably greater riding habit than level cities, in which there are relatively few disadvantages to walking. These characteristics must be considered in attempting comparisons.

### Climatic Conditions

The riding habit of the resident population of any city will be affected considerably by climatic conditions. A city such as Denver with an unusual number of days in which walking is pleasant will develop a considerable number of pedestrians.[1] On the other hand, such a city with an ideal climate usually attracts a considerable number of tourists. The presence of these visitors tends to increase the total number of rides in the city and this total when divided by the resident population shows a somewhat higher number of rides per capita

[1] Toll, R. W., "Denver Traffic Investigation," Aera, October, 1914; Electiic Railway Journal, August 29, 1914 and August 21, 1915.

than would be the case otherwise. Climatic conditions, therefore, may tend to increase riding by one class of patrons and decrease riding by another class. It is evident, however, from a study of the number of rides per capita in various parts of the country that climatic conditions are a determining factor in the total riding in the community.

### Temperamental Characteristics of Resident Population

The people of certain communities are given to attendance at places of amusement to a greater extent than those of other communities and this characteristic affects the rides per capita. The temperamental characteristics may also affect the amount of riding, in that the saving of time will appear to be of more importance in some communities than in others. In a community where wages are high it is evident that it will be an economy to ride more frequently than in a community where wages are low.

### Competitive Facilities

As has been pointed out in a previous chapter, [1] the only method of transportation which can compete with the electric railway on the basis of cost, is walking, but there are, of course, frequent occasions when some other factor than cost determines for the individual his means of transportation. At such times as this, the presence, the degree of excellence, and the relative cheapness of competitive facilities combine to determine whether the journey shall be made by electric cars or otherwise. In comparing two cities, then, as to the riding habit of their population, attention should be given to the extent of the use of private automobiles,[2] of taxicabs, of motor buses and

[1] Chapter XVIII, " Cost of Competing Forms of Transportation."

[2] Automobiles in the United States

| Year | Produced | In use | Population per automobile in use |
|---|---|---|---|
| 1903 | 11,000 | 40,000 | 2,020 |
| 1904 | 22,000 | 50,000 | 1,648 |
| 1905 | 25,000 | 80,000 | 1,050 |
| 1906 | 34,000 | 120,000 | 713 |
| 1907 | 44,000 | 180,000 | 484 |
| 1908 | 85,000 | 250,000 | 355 |
| 1909 | 126,000 | 350,000 | 258 |
| 1910 | 187,000 | 500,000 | 184 |
| 1911 | 210,000 | 677,000 | 138 |
| 1912 | 376,000 | 1,010,000 | 94 |
| 1913 | 450,000 | 1,254,000 | 77 |
| 1914 | 515,000 | 1,711,000 | 57 |

From figures prepared by Roger W. Toll, Chief Engineer, Denver Tramway Co., from various sources.

for suburban traffic of steam railway transportation. Unless these factors can be analyzed — and it has been found to be a very difficult matter — the results to be gained by comparison of the riding habit in one city with that in another city are unreliable.

## Special Conditions

In addition to the five factors enumerated, certain other local conditions affecting riding habit should be given consideration. Among these are the relative location of business and residence sections. A city in which the residence district comprises the northern half and the business district the southern half will naturally develop a considerably greater habit of riding than one in which business and residence districts lie in concentric rings or zones of, say, half a mile in width. In the latter city, there would tend to develop districts comprised of the residences of individuals working in the adjacent business zones, and to a relatively large extent, it would be possible for these individuals to reach their places of business without riding.

The presence of features that attract floating population also influences the apparent riding per capita because in determining this figure it is customary to divide the total rides by the resident population alone. In addition to bringing people into a city from other communities, the existence in a city of attractive parks will stimulate to a considerable extent riding during the summer and to a lesser extent on Sundays and holidays throughout the year. It has been generally observed that riding increases with population in any city but it has not been definitely pointed out in any case whether this increase in riding occurs because of an increase in population or whether it occurs because increased population means an increased area with consequent longer distances; whether it means the presence of features which attract floating population; whether the park and amusement attractions in such cities increase as the population increases; or whether any other factors which might have an influence upon riding habit are to be given more weight than the increase in population itself.

It is apparent from the foregoing, that very great difficulty is to be encountered in attempting to measure the effect of rate of fare on riding habit by a comparison of street railway statistics for various cities. Further, it would seem not unlikely in comparing the riding in any city for different periods of time, that some of the factors here outlined might render such a comparison unsatisfactory.

Confining the study to the experiences of individual cities rather than comparisons of several cities, it will be of interest then, to consider the city of Cleveland, Ohio, where there has been in effect during the past twelve years a large number of different rates of fare and to determine if possible whether there is any high degree of correlation in this city between the rate of fare and the riding habit, and incidentally to ascertain whether any other factor, such as the general industrial condition, has not a closer relation in its

fluctuations to changes in riding habit than do changes in the rate of fare.

It is observed in Cleveland, that during the period of twelve years, there has been a decrease in the rate of fare accompanied by an increase in rides per capita. It is found, however, that a similar increase in riding habit has occurred in other cities, and as frequently and to as great an extent in cities in which the fare has been unchanged as in those in which the fare has been lowered. It is also found that in but seven of the twelve periods was the reduction in rate of fare accompanied by an increase in riding or an increase in rate of fare by a decrease in riding.

It is generally true that post office receipts and bank clearings, each a measure of industrial activity, increase at a greater rate than population and such has been true in the case of Cleveland. Of particular importance in the present study is the fact that the variation in riding habit shows a much closer relation to these measures of industrial activity, than it does to variations in rate of fare.

Comparing these fluctuations it is found that the degree of correlation between changes in rate of fare and changes in riding habit is 0.52; between changes in bank clearings per capita and in riding habit is 0.88, and between changes in post office receipts per capita and riding habit is 0.79. Since 1.00 denotes complete and direct correlation,

TABLE C — COMPARISON OF RIDING — THREE YEARS — CLEVELAND ELECTRIC RAILWAY COMPANY

| Months | 1902 | | 1903 | | 1904 | |
|---|---|---|---|---|---|---|
| | Revenue | Number of fares | Revenue | Number of fares | Revenue | Number of fares |
| January | 4,750 | 100,000 | 5,334 | 112,280 | 4,908 | 114,458 |
| February | 4,750 | 100,000 | 5,365 | 113,050 | 5,191 | 121,337 |
| March | 4,750 | 100,000 | 5,246 | 110,780 | 5,063 | 115,577 |
| April | 4,750 | 100,000 | 5,432 | 114,420 | 5,462 | 116,594 |
| May | 4,750 | 100,000 | 5,306 | 111,720 | 5,293 | 112,457 |
| June | 4,750 | 100,000 | 5,262 | 111,030 | 5,458 | 116,148 |
| July | 4,750 | 100,000 | 4,927 | 111,790 | 5,128 | 109,040 |
| August | 4,750 | 100,000 | 4,876 | 112,620 | 5,123 | 108,791 |
| September | 4,750 | 100,000 | 4,888 | 113,370 | 5,142 | 109,130 |
| October | 4,750 | 100,000 | 4,783 | 111,200 | 5,123 | 108,687 |
| November | 4,750 | 100,000 | 4,577 | 106,710 | 5,076 | 107,766 |
| December | 4,750 | 100,000 | 4,568 | 106,470 | 5,211 | 110,292 |

it is obvious that the general business conditions of prosperity and depression affecting bank clearings and post office receipts exercise a greater influence on riding habit than does rate of fare.[1]

[1] For method pursued in determining the measure of correlation, see technical notes appended to this chapter.

Examining some of the individual increases and decreases, the comparisons are as follows:

The rate of six tickets for 25 cents was in effect in Cleveland, from July 4, 1903, to March 22, 1904. During the calendar year 1902, and the first six months of 1903, the average fare was 4.75 cents.

In Table C there is shown the situation before, after and during the period of reduced rate of fare. It is not clear how much of the change in riding observed was due to the change in rate of fare. In order to eliminate seasonal variation and to facilitate comparisons, the table is constructed by assuming 100 000 fares and $4 750 revenue for each month in 1902. These figures are multiplied by the actual percentage changes as shown by the books of the company for the corresponding months of the three years.

Summarized, the decrease in fare affected riding habit and revenue as shown in Table CI:

TABLE CI — EFFECT OF 8.5 PER CENT REDUCTION IN FARE — CLEVELAND ELECTRIC RAILWAY CO.

| PERIOD | Rate of fare | Average | |
|---|---|---|---|
| | | Fares per month | Revenue per month |
| 15 months | 4.72 cents | 111,479 | $5,264 |
| 9 months | 4.32 cents | 112,615 | 4,865 |
| | Decreased 8.51 % | Increased 1.02 % | Decreased 7.58 % |

From January 23, 1905, to February 4, 1905, the Cleveland Electric Railway Co. had in effect a rate of three cents applicable within a limited area. This fare was available for 13 hours of the day. The records of the company show that 18.5 per cent of the riders took advantage of this reduced rate and that the average number of rides per day was only 1 per cent greater than during the 20-day period preceding January 23.

The result per 100 passengers is summarized in Table CII.

TABLE CII — EFFECT OF 6.7 PER CENT REDUCTION IN FARE — CLEVELAND ELECTRIC RAILWAY CO.

| PERIOD | Rate of fare | Number of fares | Revenue |
|---|---|---|---|
| Before January 23 | 4.77 cents | 100 | $4.77 |
| January 23–February 4 | 4.55 cents | 101 | 4.49 |
| | Decreased 6.71 % | Increased 1 % | Decreased 5.87 % |

Following this experiment there was put into effect a rate of four cents, transfers being given, however, only to those passengers paying the regular rate of fare, five cents or 22 tickets for a dollar. Accompanying the four cent rate there was a decrease in revenue of 11 per cent and an increase in riding of 1 per cent.

During 1907, still another experiment was tried in Cleveland. In January, February, March and October, tickets were sold at the rate of seven for 25 cents. In the other months, the rate was eleven tickets for 50 cents. Eliminating seasonal variation in the same manner as was done in considering the rates of fare in effect in 1903 and 1904, the situation during the 1907 test is shown in Table CIII.

Table CIII — Comparison of Riding — Two Years — Cleveland Electric Railway Co.

| Month | 1906 | | 1907 | |
|---|---|---|---|---|
| | Revenues | Number of fares | Revenues | Number of fares |
| January | 4,750 | 100,000 | *4,266 | 116,100 |
| February | 4,750 | 100,000 | *4,289 | 118,360 |
| March | 4,750 | 100,000 | *4,388 | 121,370 |
| April | 4,750 | 100,000 | 4,988 | 115,350 |
| May | 4,750 | 100,000 | 5,133 | 110,050 |
| June | 4,750 | 100,000 | 4,952 | 106,370 |
| July | 4,750 | 100,000 | 5,202 | 110,960 |
| August | 4,750 | 100,000 | 5,160 | 110,780 |
| September | 4,750 | 100,000 | 4,958 | 106,530 |
| October | 4,750 | 100,000 | *4,282 | 111,470 |
| November | 4,750 | 100,000 | 4,573 | 109,520 |
| December | 4,750 | 100,000 | 4,671 | 101,640 |

* Reduced fare in effect.

The results shown in Table CIII are summarized in Table CIV.

Table CIV — Effect of 19.1 Per Cent Reduction in Fare — Cleveland Electric Railway Co.

| Period | Rate of fare | Average | |
|---|---|---|---|
| | | Fares per month | Revenue per month |
| | *Cents* | | |
| 8 months | 4.55 | 108.900 | $4,955 |
| 4 months | 3.68 | 116.825 | 4,304 |
| | Decrease 19.1 % | Increase 7.3 % | Decrease 13.1 % |

It is worthy of note in connection with the various rates of fare tried in Cleveland, that the fare question was, during the time of these experiments, a prominent political issue, and that every effort was made by the city government and by those interested in the success of low fares to stimulate riding during the trial periods.

The experience of Detroit is of interest.[1] Prior to August 15, 1913, the average fare on certain parts of the Detroit United Railway's system was 4.4 cents; at this time the fare was reduced to seven tickets for 25 cents. During the eight month period, January to August, 1913, inclusive, the number of rides on these lines was 16.5 per cent greater than during the corresponding period in 1912. The riding in 1914 for these months showed an increase of but 7.5 per cent over that in 1913, while the later months of 1914 showed a decrease in number of rides from 1913.

The recent experience of Vancouver and Victoria is likewise instructive.[2] As a matter of public policy and to meet the situation created by business depression and jitney competition the British Columbia Electric Railway inaugurated a rate of eight tickets for 25 cents for non-transfer rides. During the previous year due to a material decrease in population and a serious industrial situation the traffic of this company fell off 11.9 per cent. It was therefore in a position to handle an increase in traffic without the normal increase in total costs. Following the inauguration of the lower fare there was an increase in traffic of 25 per cent on the lines affected and an increase in revenue of 3 per cent, the average reduction in fare being 17 per cent. Under ordinary circumstances 25 per cent increase in traffic would occasion an increase in costs very materially in excess of 3 per cent. A very considerable part of this increased riding resulted from the diverting of traffic from jitney buses. It is unlikely that much additional business was created.

Similar to the studies made of the Cleveland data, the coefficient of correlation of riding habit and rate of fare was computed for Milwaukee. In this city the average fare was 4.56 cents in 1900 and 4.18 cents in 1913. The rides per capita were 134 in 1900 and 247 in 1913.[3] There is evident both an increased use of transportation facilities and a general downward tendency in rate of fare during this period. The rate of increase has not, however, varied in such a way as to indicate a causal relation between riding habit and rate of fare. In six of the thirteen periods riding has increased with an increased rate of fare or decreased with a decreased rate of fare. The degree of correlation between fluctuations in rides per capita and in rate of fare mathematically determined is found to be 0.52.

Among foreign cities, Glasgow is frequently cited as an example

---

[1] Irwin Fullerton, General Auditor Detroit United Railways, in *Street Railway Bulletin*, April, 1914, and *Electric Railway Journal*, April 4, 1914.
[2] *Electric Railway Journal*, July 17, 1915.
[3] For data upon which the conclusion is based, see Technical Notes appended to this chapter.

of low fares and consequent dense traffic.[1] The actual experience of this city is of interest. A reduction in rate of fare was made effective on December 10, 1911, by changing somewhat the length of ride for the minimum fare of one-half penny. Table CV shows the situation on the Thursday preceding Christmas in 1910 and in 1911. It may be safely assumed that the increased riding at the two lowest rates of fare was due in part to a general increase in riding in the city and would have taken place regardless of any changes in fare. This normal growth of 4 per cent is, however, neglected in the following figures.

TABLE CV — COMPARISON OF RIDING — GLASGOW CORPORATION TRAMWAYS

| Rate of Fare, | Thursday, December 21, 1911 | | | | Thursday, December 22, 1910 | | | |
|---|---|---|---|---|---|---|---|---|
| | Passengers[2] | Revenues | Per cent | | Passengers[2] | Revenues | Per cent | |
| | | | Passengers | Revenues | | | Passengers | Revenues |
| *Pence* | | *Pence* | | | | *Pence* | | |
| ½ | 501,995 | 250,997 | 61.44 | 40.61 | 189,898 | 94,949 | 29.27 | 15.76 |
| 1 | 244,378 | 244,378 | 29.91 | 39.53 | 390,767 | 390,767 | 60.23 | 64.85 |
| 1½ | 50,692 | 76,038 | 6.20 | 12.30 | 49,795 | 74,692 | 7.67 | 12.40 |
| 2 | 12,353 | 24,706 | 1.51 | 4.00 | 11,521 | 23,042 | 1.77 | 3.82 |
| 2½ | 4,218 | 10,545 | 0.51 | 1.71 | 3,717 | 9,293 | 0.57 | 1.54 |
| 3 | 1,885 | 5,655 | 0.23 | 0.91 | 1,673 | 5,019 | 0.25 | 0.83 |
| 3½ | 1,324 | 4,634 | 0.16 | 0.75 | 1,232 | 4,312 | 0.18 | 0.72 |
| 4 | 115 | 460 | 0.04 | 0.07 | 119 | 476 | 0.06 | 0.08 |
| | 816,960 | 618,134 | 100.00 | 100.00 | 648,772 | 602,550 | 100.0 | 100.0 |
| 1½–4 | 70,587 | 122,038 | 8.65 | 19.74 | 68,057 | 116,834 | 10.50 | 19.39 |

Of 390 767 passengers riding for a one-penny fare on December 22, 1910, only 244 378 paid that fare on December 21, 1911, the balance, or 146 389, paying a half-penny fare. The increase from 189 898 to 501 995 passengers at the lowest rate may therefore be accounted for as due to the extent of 165 708 rides to increased length of haul for the half-penny rate, and to the extent of 146 389 rides as due to a decreased fare for the same length of ride.

Considering the penny and half-penny rides under the two rates of fare, the results as summarized are shown in Table CVI.

Figures are available also for the first week and for the first five weeks of the Glasgow experiment together with comparative figures for the corresponding periods of the previous year. Following the method outlined above, the results obtained are summarized in Table CVII.

[1] *Electric Railway Journal*, January 6, 1912.
[2] This represents the number of fares paid, a passenger being counted as often as he pays a fare. This should be borne in mind in comparing "average fare per ride" and "passengers per car mile" or "passengers per mile of track" with statistics of operation in American cities.

Table CVI — Effect of 20.4 Per Cent Reduction of Fare — Glasgow Corporation Tramways

| Thursday, December 21, 1911 | | | Thursday, December 22, 1910 | | |
|---|---|---|---|---|---|
| Fare | Passengers | Revenues | Fare | Passengers | Revenues |
| *Pence* | | *Pence* | *Pence* | | *Pence* |
| ½ | 501,995 | 250,997 | ½ | 189,898 | 94,949 |
| 1 | 244,378 | 244,378 | 1 | 390,767 | 390,767 |
| 0.664 | 746,373 | 495,375 | 0.837 | 580,665 | 485,716 |
| Decreased 20.4% | Increased 28.5% | Increased 1.99% | | | |

Table CVII — Effect of Various Percentage Reductions in Fares — Glasgow Corporation Tramways

| Period | Per cent change | | |
|---|---|---|---|
| | Rate of fare | Passengers | Revenue |
| *One day:* | | | |
| December 22, 1910 | 20.4 Decr. | 28.5 Incr. | 1.99 Incr. |
| December 21, 1911 | | | |
| *One week ended:* | | | |
| December 17, 1910 | 20.4 Decr. | 24.3 Incr. | 1.42 Decr. |
| December 16, 1911 | | | |
| *Five weeks ended:* | | | |
| January 14, 1911 | 20.2 Decr. | 24.9 Incr. | 0.27 Decr. |
| January 13, 1912 | | | |

It is impossible to apply the results of this experiment in Glasgow to conditions in the United States. The chief competitor of the street railway is the individual who walks, and such competition is, of course, greatest for short distance journeys. When the fare is below the point where short distance travelers find the sacrifice of money for riding comparatively less than the sacrifice of time and effort in walking, riding will be increased. The standard of wages in any community will have a considerable effect upon the sacrifice represented by any rate of fare, and therefore the result of a reduction in fare in Glasgow permits no conclusions to be drawn as to the results which might be expected to follow similar experiments in cities in the United States.

It is, however, obvious that the costs of a 28.5 per cent increase in the number of rides cannot be met by 1.99 per cent increase in revenue. The financial difficulties arising from the lowered fare are even more striking when the results of the first five weeks of opera-

tion are considered. For this period with an increase of 24.9 per cent in rides, there was a decrease of 0.27 per cent in revenue.

With respect to the experience of individual cities in which changes have occurred in the rate of fare it is apparent that such correlation as exists between rate of fare and riding habit is very small if not negligible. It is clear that other factors such as the general industrial conditions of the city have a more important effect upon riding habit. Comparison of riding habit in a number of cities indicates also that riding habit has no relation to rate of fare. These comparisons, however, are inconclusive, due to the large number of dissimilar factors which affect the reliability of the comparison.

The same conclusion has been reached with respect to so-called mathematical rules for predicting future riding with increase in population. An investigation of the situation in a number of cities shows in general an increase in riding at a rate greater than that of the increase in population, at times greater even than the square of population, but this coefficient would indicate that there are other factors than growth in population to be considered and that there is no very close relation between population and riding habit.

The Committee on Cost of Passenger Transportation Service has in its preliminary report included a critical summary of the technical discussion of other writers upon this subject, and these conclusions may be here restated.[1]

The existence of so-called laws of growth based upon statistical studies covering a large number of instances are, however, repeatedly referred to, and it is important that the facts upon which they are based be examined into, not only for the purpose of defining their limitations but also with the end in view of reaching conclusions as to the limits under which no service is remunerative. Among such studies are those of Mattersdorf,[2] a German engineer, who has made extended statistical analyses of traffic, growth in population and revenues, based upon the returns of German street railways, contained in the 1905 supplement of the "Zeitschrift für Kleinbahnen." A similar study based upon returns of street railways in the United States — contained in the census reports for 1902 and 1907 — is that made by Watkins for the Public Service Commission, First District, New York.[3] A study of the relation of growth of earnings to population is contained in the Arnold report on the Pittsburgh Transportation Problem.[4]

It is Mattersdorf's conclusion that the amount of traffic measured in the number of passengers carried may be expected to increase in cities up to 500 000 population as the square of the population, but in the

---

[1] Passenger Transportation Cost, AERA, July, 1914.

[2] A portion of Mattersdorf's conclusions are contained in the *Street Railway Journal*, June 2, 1906. His more extended conclusions are contained in his "Stadtische Verkehrsfragen" (Problems of City Traffic), Dr. Ing. Wilhelm Mattersdorf, Berlin, 1907.

[3] New York Public Service Commission, First District Annual Report 1910, Vol. III, pp. 22–53. Reprint in *Engineering and Contracting*, July 10, 1912. George P. Watkins, The Relation of Increase of Street Railway Traffic to Increase of Population.

[4] Bion J. Arnold — Report on the Pittsburgh Transportation Problem, p. 139 ff.

cities above this population only in direct proportion. In other words, in the smaller cities where population doubles, traffic may be expected to increase fourfold. Mattersdorf's separate conclusions are stated by him as follows:[1]

The number of passengers carried and the car-kilometers run increase as the square of the population, while the length of the system and the passenger density increases directly with the population.

Rides per capita and car-kilometers per capita, car density or car-kilometers per kilometer of track, and income per car-kilometer tend to reach a point of saturation.

The number of passengers and of car-kilometers run increase as the square of the length of line, while the passenger density increases directly with the length of line.

The passengers carried increases directly with the car-kilometers.

The car-kilometers per capita increase to a saturation point, in relation to passengers carried, and then decrease.

In relation to car-kilometers per capita, there is a quadratic increase in the rides per capita up to a certain point, of average passengers per car and of income per car-kilometer.

The income per car-kilometer varies directly with the average passengers per car.

Attention is properly called to the fact that Mattersdorf does not claim for his conclusions a universal application as immutable as a law of physics, as has been attributed to him. "How the foregoing fundamental rules may be applied," he states, "in practical financing and operating questions, need not be especially considered in this article. It may be enough to state that the establishment of such rules does not reduce the necessity of properly combining the various factors in the study of a particular case. It may, however, be of some assistance in such an examination." It should be noted also that the rides per capita per annum and the various factors of traffic density disclosed in Mattersdorf's diagrams indicate conditions dissimilar to typical American cities where data is available so that the question as to whether these conclusions would be substantially confirmed by similar studies in this country is open to conjecture.

In making prediction as to future traffic requirements in New York City, Watkins, in the Public Service Commission, First District, 1910 Report, points out that the quadratic formula of Mattersdorf is similar to the rule sometimes applied in estimating prospective traffic on steam roads,[2] but does not hold in all cases, and when carried beyond a point of saturation reduces itself to a manifest absurdity.

"If rides increase in the proportion of the square of population," he says, "the number of rides per capita must increase in the same proportion as the population. A city of 30 000 may have traffic amounting to 100 rides per capita per year. Taking this as a somewhat arbitrary starting point for our mathematical assumption, we may compute hypothetical traffic figures for any size of urban center. A city of 100 000 should, on this basis, have 333 rides per capita and

[1] *Street Railway Journal,* June 2, 1906.

[2] "Productive traffic varies as the square of the number of tributary sources of traffic." Wellington, Railway Location, 6th edition, 1908, p. 713.

one of a million, 3 333. On the other hand, if a city of 500 000 has 200 rides per capita, one of 50 000 should have but 20 and one of 5 000 000 should have 2 000 rides per capita. Six rides a day for every man, woman and child in the community is a very high average. According to this a person in the prime of life would be taking about twelve rides per day. It would seem that he could scarcely have time to do much else. The fact is, there must be a saturation point for traffic, in the neighborhood of which the number of rides per capita will increase very slowly."[1]

The mathematical rule proposed by Watkins is that traffic will increase at a rate per cent twice that of the increase of population[2] rather than at the same ratio as population, or as the square of the population, and supports this by an analysis of statistics of 31 American cities. He is careful to state also that "No one claims that any of these formulae are more than rough working approximations."

The same general rule which has been developed by Dr. Mattersdorf, with respect to population and traffic, is reached by Mr. Arnold, with regard to probable increases in earnings.[3] "A study," he states, "of the relative growth of population and of transit earnings of the large American cities, during the past ten years, shows some surprising results, and points to the conclusion that as a rule, the earnings from local transportation increase as the square of the population. Upon this assumption, it is estimated that when the population of Pittsburgh district reaches two million, annual passenger income will aggregate forty million or $20 per capita."

A popular impression which has become current from this and similar conclusions, is that because of such assured increases in gross

---

[1] New York Public Service Commission Report, First District, 1910, Vol. III, p. 30.

[2] A recent criticism of Watkins' rule is made by an Italian engineer, Renzo Norsa, who has made a personal inspection and report of traffic conditions in the United States. Norsa points out that the quadratic rule as he interprets it from Watkins' diagram is identical with the percentage rule proposed.

"With regard to diagram D," (Public Service Commission Report, 1910, p. 41, diagram D) "logarithmic scales have been adopted both for ordinates and abscissae, that is, for ordinates logarithms of traffic are used and for abscissae, logarithms of population. In such a diagram all the exponential curves of the type $T=kP^n$" ($T$ being traffic, $P$ being population) "become straight lines, because log. $T$ equals log. $k$ plus $n$ log. $P$ and their inclination on the axis gives a direct measurement of the exponent $n$.

"Watkins proposes to substitute for the quadratic rule, the following: The per cent increase of traffic is double the per cent increase of the population. This rule should have the advantage of giving a slower variation of traffic than that which corresponds to the quadratic rule, and based on it Watkins would obtain the curve indicated in diagram C. (Public Service Commission Report, 1910, p. 40, diagram IV.) However, not agreeing for the most part with the other conclusions from Watkins' diligent study, this proposition does not seem acceptable to us.

"In fact the quadratic rule $T=kP^2$" (when differentiated) "gives

$$\frac{dT}{T} = \frac{2dP}{P}$$

which is still the quadratic rule and which is then what Watkins' rule states. The reason why Watkins finds a curve which is removed from the quadratic is that he applies his rule to determined values of the population and they are 100,000, 200,000, etc., while the quadratic rule is a continuous rule, that is, it serves for any value of the population.

"Finally, it must be observed that there are also cities in which traffic has been developed much more rapidly than would correspond to the quadratic rule." Renzo Norsa — Problems di Traffico Urbano e Ferrovie Metroppolitane Agli Stati Uniti, Milan, 1913 (Problems of Urban and Metropolitan Railway Traffic in the United States), p. 23.

[3] Bion J. Arnold, Report on the Pittsburgh Transportation Problem, p. 139.

earnings, increases in net earnings will likewise prove substantial and this has been urged as a justification for reduced rates.

It is to be regretted that the conclusions of Mattersdorf, as to the relation of population and earnings, which supplement his investigations of the quadratic rule[1] have not been given the same publicity in this country as his conclusions as to traffic. Reducing passenger earnings for various German surface traction lines to the same comparative basis, and plotting the results, Mattersdorf shows that revenue per car kilometer increases as the number of passengers per capita per annum, up to from 80 to 100 passengers per capita, and *is then a decreasing quantity for greater densities of traffic.* When it is considered that these conclusions are summarized in most cases from zone systems of fare which yield a greater relative compensation for longer hauls than is possible under the systems of flat rates for any distance in vogue in this country, that rides per capita upon American surface lines generally exceed the transition point of about 100 rides, and that operating expenses may be expected to keep pace with the car miles run, it is probable that careful investigation will disclose that optimistic expectations of increased net returns with growth of population are not borne out by experience.

With the greater increase in population in the outskirts of the city, it is apparent that there must follow an increase in long haul traffic, which, under a flat rate system of charges, is the least remunerative traffic. Mr. R. B. Stearns has pointed out the results of a study of the amount of such increases made in Milwaukee.[2] When the past records of population are separated into zones and the usual forecasts of future growth are made, it is found that the relatively greater increase in population will occur where, under present flat rates, it is a source of the greatest additional expense to the company. Such prognostications of Mr. Stearns indicate that while 93.3 per cent of the total revenue passengers in Milwaukee in 1912 were contained in the 3.5 mile zone, this may be expected to decrease to 76.5 per cent of the total in 1930, outlying zones on the other hand showing corresponding increases.

In isolated cases conclusions of technical interest may no doubt be reached, after the elimination of the great number of other factors affecting riding habit, which have been summarized in this study. It is apparent, however, from the detailed analysis of correlation in Cleveland and Milwaukee, that predictions as to future patronage must discount the future periods of prosperity and depression so intimately associated with the passenger's ability and desire to ride. Such a task is analogous to the statistical studies which have been made upon the probability of panics and the possibility of rise and decline of the stock market,— a problem of forecast, which in the present state of the art, is considerably less advanced toward solution than the theories of prediction of the weather.

---

[1] W. Mattersdorf, Problems of City Traffic, Berlin, 1907, Illustration 24.

[2] R. B. Stearns, A Zone System of Fares, Proceedings *American Electric Railway Association*, 1912.

**TECHNICAL NOTES TO CHAPTER XIX — STATISTICAL METHOD OF DETERMINING DEGREE OF CORRELATION OF RIDING HABIT, AND RATE OF FARE AND OTHER FACTORS**

(1) *Data.* Table 1 shows for Cleveland, Ohio, the yearly variation in population, number of street railway passengers, passenger revenue, and certain community characteristics. The figures for population are those given by the United States Census for 1900 and 1910. The populations for other years were determined by geometric interpolation. Figures for bank clearings were taken from the Commercial and Financial Chronicle. Post office receipts were furnished by the Cleveland Post Office. Other figures were taken from the reports of The Cleveland Railway Co. and its predecessors.

(2) *Problem.* It is desired to measure the degree of correlation of the data shown in Table CVIII.

(3) *Method. Reduction of data to a common basis of measurement.* It is observed from Table CVIII that the items have generally increased to a greater or less degree during the 13-year period with the increase in population. Since we are interested in the effect of changes in rates of fare on the individual it is necessary to reconstruct Table CVIII by reducing the data to a per capita basis. It will further facilitate comparisons to express rate of fare not in cents but in rides per dollar, and this has been done. The data so expressed are shown in Table CIX.

TABLE CIX — PER CAPITA DATA

| YEAR | Population | Fares per dollar of revenue | Rides per capita | Bank clearings per capita | Post Office receipts per capita |
|---|---|---|---|---|---|
| 1902 | 412 364 | 21.043 | 219.77 | $1 849.35 | $3.07 |
| 1903 | 428 570 | 22.104 | 235.19 | 1 871.80 | 3.21 |
| 1904 | 445 413 | 21.650 | 228.21 | 1 558.31 | 3.25 |
| 1905 | 462 918 | 21.267 | 241.07 | 1 673.47 | 3.40 |
| 1906 | 481 111 | 21.186 | 253.95 | 1 740.86 | 3.67 |
| 1907 | 500 019 | 23.596 | 272.49 | 1 794.27 | 3.81 |
| 1908 | 519 670 | 27.292 | 259.87 | 1 442.93 | 3.86 |
| 1909 | 540 093 | 23.535 | 268.43 | 1 623.45 | 4.03 |
| 1910 | 561 319 | 28.843 | 305.98 | 1 783.05 | 4.29 |
| 1911 | 583 379 | 30.797 | 325.85 | 1 735.68 | 4.47 |
| 1912 | 606 306 | 31.635 | 336.67 | 1 897.39 | 4.76 |
| 1913 | 630 134 | 31.786 | 351.35 | 2 024.17 | 5.10 |
| 1914 | 654 898 | 30.883 | 352.82 | 1 889.71 | 5.14 |
| Total | 6 826 194 | 335.617 | 3 651.65 | $22 884.44 | $52.06 |
| Mean | 525 092 | 25.817 | 280.90 | 1 760.34 | 4.05 |

The items per capita, moreover, vary greatly in size. It is therefore necessary to reduce all items to comparable units. This is done

TABLE CVIII — ORIGINAL DATA — CLEVELAND, OHIO

| Year | Population | Number of passengers | Passenger revenue | Average fare | Bank clearings | Post Office receipts |
|---|---|---|---|---|---|---|
| | | | | (*cents*) | | |
| 1902 | 412,364 | 90,623,178 | $4,306,491 09 | 4.752 | $762,604,187 | $1,266,896 |
| 1903 | 428,570 | 100,794,358 | 4,560,111 15 | 4.524 | 802,198,631 | 1,376,335 |
| 1904 | 445,413 | 101,646,643 | 4,695,442 97 | 4.619 | 694,092,850 | 1,449,555 |
| 1905 | 462,918 | 111,597,003 | 5,247,598 02 | 4.702 | 774,678,269 | 1,575,862 |
| 1906 | 481,111 | 122,176,132 | 5,767,185 57 | 4.720 | 837,548,334 | 1,767,061 |
| 1907 | 500,019 | 136,252,561 | 5,774,500 60 | 4.238 | 897,170,784 | 1,906,954 |
| 1908 | 519,670 | 135,047,446 | 4,948,192 96 | 3.664 | 749,846,710 | 2,005,405 |
| 1909 | 540,093 | 144,976,523 | 6,159,848 84 | 4.249 | 876,816,091 | 2,178,957 |
| 1910 | 561,319 | 171,753,896 | 5,955,954 42 | 3.467 | 1,000,857,953 | 2,410,781 |
| 1911 | 583,379 | 190,093,623 | 6,171,991 78 | 3.247 | 1,012,557,805 | 2,609,043 |
| 1912 | 606,306 | 204,126,792 | 6,452,864 91 | 3.161 | 1,150,397,653 | 2,885,084 |
| 1913 | 630,134 | 221,399,487 | 6,966,129 42 | 3.146 | 1,275,501,014 | 3,214,630 |
| 1914 | 654,898 | 231,063,734 | 7,482,506 32 | 3.238 | 1,237,568,572 | 3,366,991 |
| Total | 6,826,194 | 1,961,551,376 | $74,488,818 05 | ........ | $12,071,838,853 | $28,146,563 |
| Mean | 525,092 | 150,888,567 | 5,729,909 08 | 3.979 | 928,602,989 | 2,154,889 |

by the usual statistical expedient of index numbers by which, in this case, each item is expressed as a percentage of the mean value of all the items in that class for the 13 years. Table CX shows the index numbers so derived.

TABLE CX — INDEX NUMBERS

| YEAR | Rides per capita | Fares per dollar of revenue | Bank clearings per capita | Post office receipts per capita |
|---|---|---|---|---|
| 1902 | 78.24 | 81.51 | 105.06 | 76.66 |
| 1903 | 83.73 | 85.62 | 106.33 | 80.16 |
| 1904 | 81.24 | 83.86 | 88.52 | 81.16 |
| 1905 | 85.82 | 82.38 | 95.07 | 84.90 |
| 1906 | 90.41 | 82.06 | 98.89 | 91.64 |
| 1907 | 97.01 | 91.40 | 101.93 | 95.14 |
| 1908 | 92.51 | 105.71 | 81.97 | 96.39 |
| 1909 | 95.56 | 91.16 | 92.22 | 100.63 |
| 1910 | 108.93 | 111.72 | 101.29 | 107.13 |
| 1911 | 116.00 | 119.29 | 98.60 | 111.62 |
| 1912 | 119.85 | 122.53 | 107.79 | 118.86 |
| 1913 | 125.08 | 123.12 | 114.99 | 127.35 |
| 1914 | 125.60 | 119.62 | 107.35 | 128.35 |

Fig. 43 shows graphically the trend of the index numbers in Table CX.

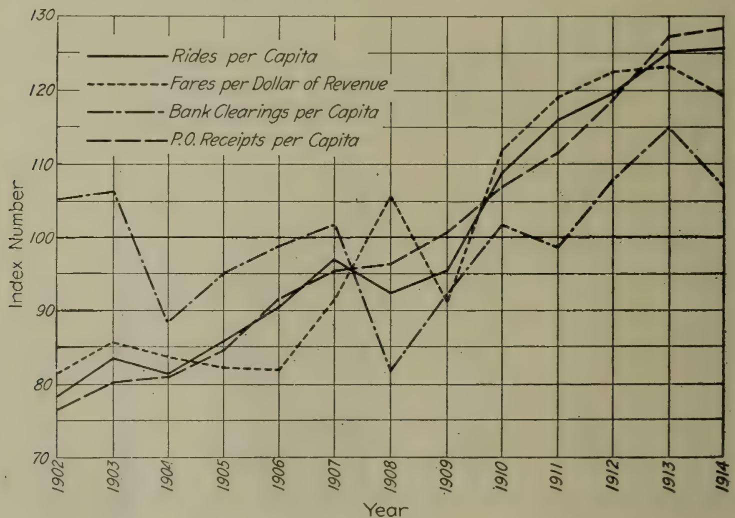



FIG. 43 — YEARLY VARIATION IN INDEX NUMBERS.

(4) *Method — Determining Correlation by Inspection.* It is noted from Fig. 43 that in but seven of the twelve periods has an increase in the number of fares per dollar (or decrease in rate of fare) been accompanied by an increase in riding habit, or a decrease in the number of fares per dollar (or increase in rate of fare) been accompanied by a decrease in riding habit. It is apparent also that the deviations, or increases and decreases, in riding habit correspond more closely to the deviations in bank clearings and post office receipts. In other words the closeness of fit or correlation between the general progress of the community, as reflected by bank clearings and post office receipts, and riding habit, is greater than between rate of fare and riding habit.

(5) *Method — The mathematical determination of correlation factors.* The conclusions as to correlation pointed out in (4) above, may be measured by the usual statistical methods used in determining correlation factors. Due to the fact that the per capita units increase at a greater rate than population during the twelve years, it is necessary to determine this general trend and calculate the deviations not from the arithmetic mean as indicated by the index number but from the general trend.

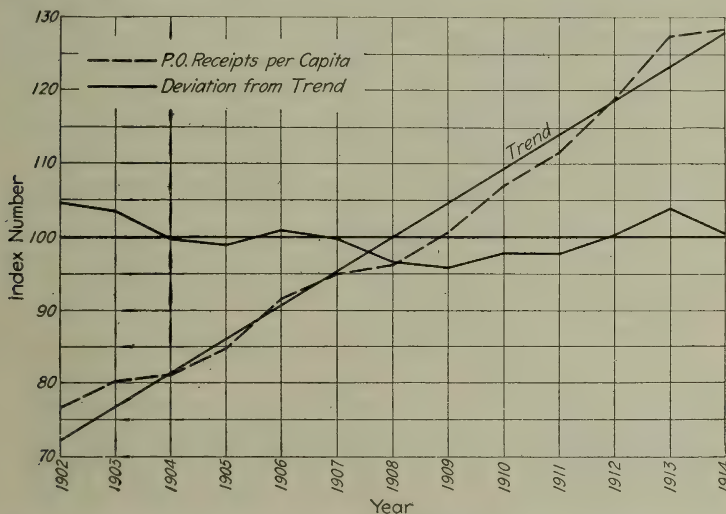



FIG. 44 — DETERMINATIONS OF SECULAR TREND AND DEVIATION FROM TREND.

Fig. 44 shows the index numbers determined for per capita Post Office receipts by a broken line. The trend is represented by a straight solid line. This straight line is so chosen that:

(*a*) The area between it and the broken line is half above and half below the line of trend; and

(*b*) The sum of all areas included between the two lines is a minimum. The trend is for all practical purposes a straight line represented by the equation $y=73+4.67x$, where $x$ represents years since 1902.

If the line of trend be rotated about the midpoint into a horizontal position the broken line representing index numbers takes the position as indicated by the solid line, deviation from trend.

Similarly the trend of revenue passengers per capita is found to be $y=73+4.5\ x$, of rate of fare, $y=76+4\ x$ and of blank clearings $y=93+1.17\ x$.

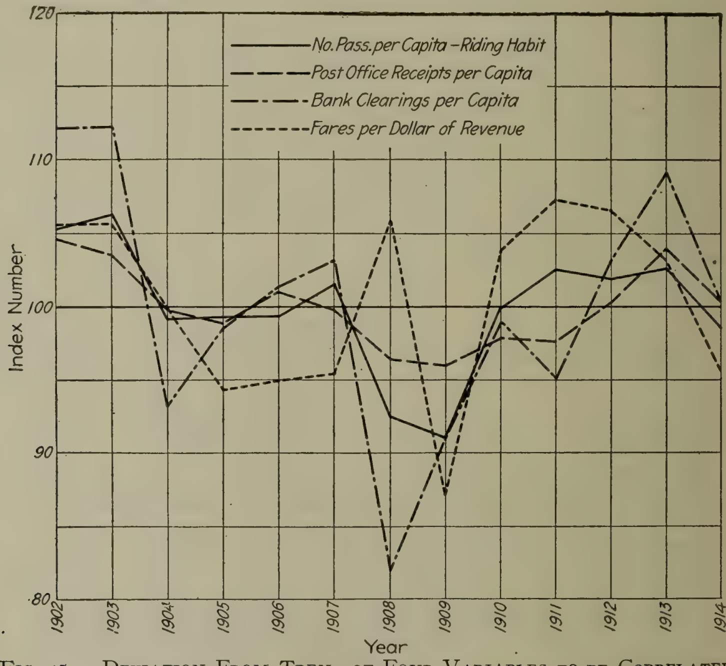



FIG. 45 — DEVIATION FROM TREND OF FOUR VARIABLES TO BE CORRELATED.

In Fig. 45 are shown the index numbers for all items after each has had its line of trend made horizontal. It is now possible to measure mathematically the degree to which the various index numbers correspond; that is, to determine the Pearsonian coefficient of correlation. A single computation will suffice to illustrate the method.

In column one of Table CXI there are shown the years covered in this analysis. Column two contains the deviation of the index numbers of rides per capita from the normal for each year as determined from the line of trend. Column three consists of the squares of the deviations or numbers in column two. Column four contains the deviations of the index numbers of Post Office receipts per capita from the normal. Column five contains the squares of deviations or

the figures in column four. Column six contains the products of the numbers in columns two and four.

The coefficient of correlation or *r*, is determined by dividing the sum of the items in column six by the product of the square root of the total of column three and the square root of the total of column five.

TABLE CXI — CORRELATION OF RIDING HABIT AND POST OFFICE RECEIPTS PER CAPITA

| 1 Years | Rides per capita | | Post office receipts per capita | | 6 Product of deviations |
|---|---|---|---|---|---|
| | 2 Deviation from trend | 3 Square of deviation | 4 Deviation from trend | 5 Square of deviation | |
| 1902 | +5.24 | 27.46 | +4.66 | 21.72 | +24.42 |
| 1903 | +6.23 | 38.88 | +3.49 | 12.18 | +21.74 |
| 1904 | —0.76 | 0.58 | —0.17 | 0.03 | +0.13 |
| 1905 | —0.68 | 0.46 | —1.10 | 1.21 | +0.75 |
| 1906 | —0.59 | 0.35 | +0.97 | 0.94 | —0.57 |
| 1907 | +1.51 | 2.28 | —0.19 | 0.04 | —0.29 |
| 1908 | —7.49 | 56.10 | —3.61 | 13.03 | +27.04 |
| 1909 | —8.94 | 79.92 | —4.04 | 16.32 | +36.12 |
| 1910 | —0.07 | 0.05 | —2.20 | 4.84 | +0.15 |
| 1911 | +2.50 | 6.25 | —2.38 | 5.66 | —5.95 |
| 1912 | +1.85 | 3.42 | +0.19 | 0.04 | +0.35 |
| 1913 | +2.58 | 6.65 | +4.02 | 16.16 | +10.37 |
| 1914 | —1.40 | 1.96 | +0.35 | 0.12 | —0.49 |
| Totals | ........ | 224.36 | ........ | 92.29 | +113.77 |

$$r = \frac{113.77}{15.0 \times 9.6} = 0.79$$

For convenience the process may be summarized in the equation:

$$r = \frac{\Sigma\,(xy)}{n\sigma_x \times \sigma_y}$$

Where $r$ is the Pearsonian coefficient of correlation, $x$ is the deviation of one function from its mean, $y$ is the deviation of the other function, $n$ is the number of items, and $\sigma_x$ and $\sigma_y$ are respectively the standard deviations of $x$ and $y$ or

$$= \sqrt{\frac{\Sigma\,(x^2)}{n}}$$

Following this method the following coefficients of correlation were determined:

Riding Habit and Rate of Fare........................ 0.52
Riding Habit and Post Office Receipts per capita....... 0.79
Riding Habit and Bank Clearings per capita........... 0.88

The correlation factor cannot exceed 1.00 positive or negative, which factor indicates complete correlation. A correlation factor of 0 indicates absolutely unrelated data. A factor of less than 0.50 indicates that the correlation is poor, 0.75 is high and factors in excess of 0.75 indicate very high correlation.

(6) Table CXII contains base data concerning Milwaukee, Wisconsin. From these data, following methods described above, the coefficient of correlation between changes in rate of fare and in riding habit it found to be 0.51, corresponding to the factor 0.52 determined from the data concerning Cleveland. The coefficient of correlation between riding habit and bank clearings per capita is found to be 0.63. This indicates, as in the case of Cleveland, a closer relation between riding habit and industrial conditions than between riding habit and rate of fare.

Table CXII — Original Data — Milwaukee, Wisconsin

| Year | Population | Revenue passengers | Passenger revenue | Bank clearings |
|---|---|---|---|---|
| | | *thousands* | | *thousands* |
| 1900 | 288 179 | 38 616 | $1 849 425 | $298 412 |
| 1901 | 296 729 | 41 839 | 2 029 049 | 327 534 |
| 1902 | 307 956 | 47 117 | 2 295 032 | 359 523 |
| 1903 | 324 582 | 52 258 | 2 550 415 | 393 893 |
| 1904 | 345 865 | 55 338 | 2 695 470 | 408 769 |
| 1905 | 343 737 | 61 529 | 2 664 747 | 430 473 |
| 1906 | 354 093 | 69 048 | 2 969 806 | 493 416 |
| 1907 | 360 635 | 75 012 | 3 211 130 | 562 344 |
| 1908 | 367 137 | 75 263 | 3 206 775 | 547 569 |
| 1909 | 371 819 | 81 057 | 3 428 807 | 602 880 |
| 1910 | 376 443 | 88 464 | 3 769 237 | 658 003 |
| 1911 | 386 186 | 92 685 | 3 957 515 | 696 733 |
| 1912 | 396 000 | 96 607 | 4 096 989 | 724 683 |
| 1913 | 405 000 | 100 074 | 4 183 696 | 786 473 |
| Total | 4 924 361 | 974 907 | $42 908 093 | 7 290 705 |

# CHAPTER XX

## THE PROBLEM OF RAPID TRANSIT

Time as a Factor in Transportation,—— Comparison with Transit Facilities in Other Cities,—— Unwarranted Conclusions,—— Elements of Cost of Rapid Transit Systems,—— Necessary Traffic Density,—— Comparison with Cost of Operation of Surface Lines,—— Cost of Operation of Elevated Lines,—— Improvement of Present Surface Traction Facilities as a Substitute for Rapid Transit.

The rapid growth in area, population and expenditures of our modern industrial communities has brought to their attention the necessity of careful city planning. In particular, during the past ten years, the difficult problems of transportation have been before many American cities. Prominent engineers and traffic experts have been called upon to investigate and report upon transportation facilities, and their reports have in many cases suggested the construction of extensive and expensive rapid transit systems. Since the opening of the New York subway in 1904 this form of rapid transit has received much attention, and at present subways in several other cities are under consideration.

One of the principal causes of the desire for rapid transit facilities is the constantly growing value of time. The numerous inventions of the past century have caused the world to move more rapidly, have brought the pleasures and enjoyments of life within the reach of an increasing number of people, and have in consequence increased the importance of time both for business and recreation. Moreover, modern complex industrial organizations frequently require tremendous concentration of population within limited urban districts. This congestion of population makes many demands upon the individual's time and the attendant discomforts have caused many to live at a considerable distance from their work. Since much time must thus be expended in traveling to and from work and since there is a desire for greater leisure, the time devoted to daily travel is becoming a factor of increasing importance. Not only has there been an increasing desire to curtail time devoted to daily travel, but there is always the individual's desire for rapid travel.

Another important cause of the desire for rapid transit facilities has been local pride. This is but the outgrowth of the democratic conception of equality. It makes the home town seem as important as New York or London, and totally neglects the differences in conditions and probable burdens and dangers of any rapid transit scheme. Unfortunately "If New York can have a subway, so can we" is an all too common statement, believed to be an argument.

Comparisons with transit facilities in other cities often lead to unwarranted conclusions as to the feasibility of rapid transit facilities.

The average citizen perceives in the crowding which he experiences in the rush hours, a volume of traffic sufficient to provide any desired facilities. He has little conception of the tremendous costs of rapid transit structures and little appreciation of the burdens their use imposes on too small a volume of traffic.

It can not be denied that rapid transit facilities carry with them certain advantages. Among these are a saving of time, through the higher speed attainable, relief of street surface congestion, and development of outlying territory with its consequent benefits in the form of increased property values. However, the difficulties are many and should be carefully weighed. The fundamental disadvantage of rapid transit is the great capital outlay required and the high fixed charges resulting therefrom. Few will undertake the construction and operation of such systems unless insured by the community against early losses[1] and unless the traffic density is sufficiently high to develop earnings which will pay the interest charges of such an undertaking after the development period.[2]

Other difficulties, such as those presented by the problem of ventilation, are constantly encountered in connection with the operation of subways. While these difficulties can be overcome, they involve discomfort to patrons and constant expenditure on the part of the operator for improvements.[3] The physical discomforts of subways are such that many people make use of them only under necessity. The elevated roads, while presenting fewer difficulties from the standpoint of the passengers, are likely to be noisy and may be obtrusive to the eye. They are often alleged to be a serious detriment to abutting property and their construction may be accompanied by the payment of considerable damages to property owners along the line.

The costs of rapid transit structures vary widely with local conditions and therefore no standard of costs can be established as

---

[1] It will be seen, therefore, that there is contained in the decision to build a long subway many serious questions of public policy. On the one hand, a change from the detached home to more crowded buildings, or, on the other hand, a postponement of this change by providing high speed facilities to carry the people to the outlying districts. In order, however, to support a long subway, either a general public contribution through increased fares on the entire railway system will be necessary or the deficit will have to be made up by taxation.— Barclay Parsons and Klapp *Report on Detroit Street Railway, Traffic and Proposed Subway.* January 1915–page 25.

[2] "In view of the enormous costs of these rapid transit facilities, it is clear that they should not be undertaken by the traction company unless it can reasonably expect a traffic density sufficient to profitably carry the charges. Under exceptional circumstances where the geography of the system concentrates a very great traffic over a considerable length of route, subways may be financially possible for the traction companies, but for cities having a wide spreading radial system of track with perhaps only a congested center, the elevated or underground railway can only be carried through that center or more probably cannot be afforded at all, if the expense is to be borne by the street railway, that is to say, by the fares paid by the users at prevailing rates." Charles S. Sergeant, "Some Financial Aspects of the Relief of Congestion by the Construction of Subways and Viaducts." 1913 *Proceedings of the American Electric Railway Association*, page 199.

[3] A rather extended discussion of the history, costs, advantages and disadvantages of rapid transit is contained in "A Study of Rapid Transit in Seven Cities" prepared July 1914, by the Chicago Municipal Reference Library, under the direction of Theodore K. Long (Municipal Reference Bulletin No. 3). The seven cities referred to are: New York, Chicago, Boston, Philadelphia, London, Paris and Berlin.

typical for all cases. Aside from the physical and financial difficulties encountered in construction, there are certain other factors which influence the cost of construction of rapid transit systems. Such costs are somewhat dependent upon the requirements of construction where streets are narrow and crooked, and the location of entrances and exits to stations may involve the condemnation of private property and thus entail considerable expenditure.[1] The protection and replacement of mains and sewer pipes for water, sewers, conduits for power and telephone circuits, etc., and the replacement of paving and sidewalks constitute still other sources of cost. Construction involves accidents with resulting personal injury and property damage claims. All these items of cost are difficult if not impossible to estimate with fair accuracy and deter many contractors from undertaking such work. The very indefiniteness of the hazards to be met further swells the total cost of construction.[2]

Table CXIII prepared by J. Vipond Davies, formerly Chief Engineer for the Hudson & Manhattan Railroad Company,[3] sets forth the approximate cost of different types of transit structures per mile of single track. This table indicates the wide range between costs of surface and other lines.

In June, 1908, the Interborough Rapid Transit Company reported to the Public Service Commission (First District, New York) that its electrical plant, land and equipment had cost as follows:

| | |
|---|---|
| Engineering and superintendence | $487 030 |
| Electric line construction | 4 552 796 |
| Buildings and fixtures used in operation | 4 571 822 |
| Power plant equipment | 6 140 776 |
| Shop tools and machinery | 70 182 |
| Cars | 8 650 059 |
| Miscellaneous | 709 655 |
| Total equipment | $25 182 320 |
| Real estate used in operation | 1 417 728 |
| TOTAL | $26 600 048 |

To this should be added the cost to the city of $51,290,468, making a total of $77,890,516.

This did not include $10,000,000, said to have been lost by contractors

[1] * * * The Tremont street subway was the first built and for a very considerable part of its length was built under the Common and Public Garden; but one station approach in addition to the northern terminus was constructed on private land. On the contrary, the Washington street tunnel or subway, while built mainly under public streets, was for a portion of its route carried under private land, and no less than ten of the station entrances and exits were placed on private land on account of the narrowness of the streets. This resulted in a cost per mile of nearly three and one-half times that of the Tremont street subway, and is a good illustration of the essential government of subway costs by local conditions.—C. S. Sergeant, "Subways and Viaducts." 1913 *Proceedings of the American Electric Railway Association*, page 199.

[2] There were two bids for the entire work * * * the contract was awarded January 16, 1890, to John B. McDonald, for the lump sum of $35 000 000 * * * The great size of the contract eliminated competition of smaller contractors and allowed high prices and a high bid. Moreover, the contractor bound himself to operate the subway for 50 years, after its completion, to install an electric power plant and to furnish adequate equipment, none of which was embraced in his $35 000 000.—*Engineering Contracting*, April 13, 1910, "The Cost of the New York Subway and of Operating It."

[3] Davies, J. Vipond, "Provision for Future Rapid Transit in Cities."—*Engineering News* (June 11, 1914), page 1333.

on the Brooklyn extension in order to remain in complete control of the situation.[1]

TABLE CXIII — COST OF TYPES OF STRUCTURE FOR DOUBLE RAILWAY TRACKS

(Does not include power or rolling stock, value of property for rights-of-way and is given on basis of constructing a double track railroad, although reduced to the cost per mile of single track.)

| DESCRIPTION | Cost per mile of single track |
|---|---|
| Trolley railroad in suburban district, either on public roads or private right-of-way where no paving is required; complete with overhead trolley construction, track bonded; all in operating condition | $25 000 |
| Trolley railroad on city streets, including asphalt or granite-block pavement for width of tracks and two feet outside of tracks; complete with overhead trolley construction, track bonded; all in operating condition | 42 000 |
| Underground trolley railroad in congested streets of a city, including necessary pavements, conduits, etc., and with reasonable allowance for changes of sub-surface improvements. | |
| New York | 126 000 |
| Washington | 48 500 |
| Elevated railroad of a type and for the loading permissible to meet requirements of Public Service Commission of New York; complete with stations, contact rail, ties and track; averages | 125 000 |
| Railroad in open cut similar to Sea Beach Railroad of Brooklyn Rapid Transit Company in Brooklyn, where work is executed with steam shovel and with concrete walls; averaging cost of bridges and stations as part of the cost; complete with contact rail, ties and track; averages | 225 000 |
| Railroad on masonry viaduct filled in with stone ballast similar to structure now being erected on Queens Boulevard from Queensboro bridge to Greenpoint, on Long Island, New York; complete with stations, contact rail, ties and track; averages | 330 000 |
| Subway such as the Fourth avenue subway in Brooklyn where work is unaffected by surface improvements where the digging is easy and can be done with steam shovel under typical ideal conditions; complete with structural and track equipment; averages | 402 000 |
| Subway such as Broadway subway, now being constructed in New York City where the work is very difficult and involves extreme interference with sub-surface improvements of all kinds, the support of street surface, trolley car tracks, underground trolley construction, etc.; complete with structural and track equipment; averages | 1 190 000 |
| Iron-lined tube-tunnels under waterways or below water level; complete with structural equipment and track; averages | 2 700 000 |

TABLE CXV — TRAFFIC DENSITY ON VARIOUS LINES*

| CITY | Passengers per route mile per annum |
|---|---|
| *American Cities* | |
| New York (Manhattan and Bronx) | 9 124 500 |
| Brooklyn (including Queens) | 3 241 200 |
| Chicago elevated lines | 2 941 800 |
| Philadelphia | 4 786 500 |
| Boston | 4 054 400 |
| *European Cities* | |
| Paris (Metropolitan) | 8 878 600 |
| Berlin | 4 730 000 |
| London "Tubes" (average of four companies) | 4 104 562 |

[1] "Cost of New York Subway and of Operating It." *Engineering Contracting*, (April 13, 1910).

* J. M. McElroy, "The Passenger Transportation Problem," 1914.

TABLE CXIV — CAPITAL INVESTED IN RAPID TRANSIT SYSTEMS*

| | Greater New York | Chicago | Philadelphia | Boston | London |
|---|---|---|---|---|---|
| *Amount at present invested:* | | | | | |
| (a) By the Company: | | | | | |
| Elevated Lines | $162 677 085 | $99 020 835 | .............. | .............. | .............. |
| Underground Lines | 116 197 915 | .............. | .............. | .............. | $261 718 752 |
| | $278 875 000 | $99 020 835 | $17 177 085 | $35 364 585 | $261 718 752 |
| (b) By the City: | | | | | |
| Elevated Lines | $10 104 165 | .............. | .............. | .............. | .............. |
| Underground Lines | 45 468 750 | .............. | .............. | .............. | .............. |
| | $55 572 915 | .............. | .............. | $9 093 750 | .............. |
| **Total amount at present invested** | **$334 447 915** | **$99 020 835** | **$17 177 085** | **$44 458 335** | **$261 718 745** |
| *Proposed future expenditure:* | | | | | |
| (a) By the Company: | | | | | |
| Elevated Lines | $67 697 915 | .............. | $16 166 665 | $6 062 500 | .............. |
| Underground Lines | 101 041 670 | $35 364 585 | 7 072 920 | 2 020 835 | .............. |
| | $168 739 585 | $35 364 585 | $23 239 585 | $8 083 335 | .............. |
| (b) By the City: | | | | | |
| Elevated Lines | $21 218 750 | .............. | $4 041 665 | .............. | .............. |
| Underground Lines | 143 479 165 | $97 000 000 | 31 322 920 | $7 072 915 | .............. |
| | $164 697 915 | $97 000 000 | $35 364 585 | $7 072 915 | .............. |
| **Total proposed future expenditures** | **$333 437 500** | **$132 364 585** | **$58 604 170** | **$15 156 250** | .............. |
| **Average cost per route mile of existing lines** | **$2 736 918** | **$1 806 931** | **$2 353 060** | **$3 317 706** | **†$3 221 516** |

* J. M. McElroy — The Passenger Transportation Problem, 1914.
† Average of four companies.
Note:— £1 taken as $4.85.

Table CXIV reproduced from a special report by J. M. McElroy, General Manager of the Manchester (England) Tramways Department, shows clearly the magnitude of the required investment in the rapid transit system of American cities and of London.[1]

It has been already pointed out that successful operation of rapid transit systems requires a high density of traffic. The following lesson, drawn from the extensive investigations of Mr. McElroy, covering the principal cities of the world, is of great interest in this connection, as is Table CXV giving the traffic density on rapid transit lines in large cities, also reproduced from his report.

> * * * On account of the great initial cost, the construction of underground rapid transit lines cannot be justified unless there is a very large volume of traffic to be dealt with; * * * underground lines, if they are to be placed upon a paying basis, must be worked by high speed trains operated at a very close headway. This demands a great density of traffic.[2]

In this connection the following statement of J. Vipond Davies is also of interest:

> * * * The Interborough Rapid Transit subway in New York * * * must haul more than 2 000 000 pay passengers per annum per mile of single track to meet fixed charges for structure and equipment; or further * * * a road which would cost for structure alone without equipment, say $500 000 per mile of double track, would have to haul at 5-cent fare 910 000 pay passengers to pay interest charges on its expenditure for that structure and if equipment were included, would have to have probably 1 400 000 pay passengers per annum.[3]

For purposes of comparison and to emphasize the fact that traffic so dense as to make possible the operation of rapid transit lines is rarely found, the following data abstracted from the 1912 report of the Bureau of the Census, on street and electric railways are cited.

TABLE CXVI — REVENUE PASSENGERS PER MILE OF TRACK

| YEAR | Companies having operating income of | | |
|---|---|---|---|
| | $1,000,000 or over, class A | $250,000 to $1,000,000, class B | Less than $250,000, class C |
| 1912 | 358 372 | 118 998 | 75 484 |
| 1907 | 361 701 | 123 390 | 74 788 |
| 1902 | 399 058 | 150 218 | 74 009 |

In Table CXVI city and interurban lines are not separated, but it appears that the large city lines are chiefly Class A companies, while in general the small lines are in Class C and the large interurbans and combined systems are in Class B.

[1] McElroy, J. M., "The Passenger Transportation Problem," City of Manchester Tramways Department, 1914, page 102.

[2] Idem, page 85.

[3] Davies, J. V., "Provision for Future Rapid Transit in Cities." *Engineering News* June 11, 1914, page 1333.

Grouping the lines as surface and rapid transit, the number of revenue passengers per mile of track was 200 386 in 1907 and 211 073 in 1912 on the former; and 1 514 866 in 1907 and 1 913 950 in 1912 on the latter. This indicates a traffic density on subway and elevated lines from seven to ten times that on surface lines.

In general, the size of a city's population is not a safe criterion of its density of traffic,[1] and other factors, such as the city's lay-out, its total area, its industrial conditions, and the relative location of business and residence areas must also be given consideration.

Offsetting in part the very heavy fixed charges of systems of rapid transit is economy of operation under heavy traffic. While a surface line having an investment of five dollars for each dollar of gross revenue per year will be able to pay six per cent return if it can confine its operating expenses including depreciation and taxes to 70 per cent of its revenue, a rapid transit system with an investment of ten dollars to one of annual revenue will be obliged to keep its operating expenses down to 40 per cent of its revenue in order to pay a six per cent return. It is needless to point out that this requires an extraordinary density of traffic.

In the following paragraphs it will be of interest to examine the operation of certain systems and to compare in detail the elements of cost of rapid transit and surface electric railways.

Table CXVII contains statistical data concerning the operation of rapid transit lines in New York and Chicago, and three surface lines located in these cities and in Cleveland. Condensed income accounts of several of these companies are given in Table CXVIII. The next to the last line of this table, showing the percentage ratio which interest, dividends, rentals and surplus bear to operating revenue was obtained by first deducting from these amounts the net income from non-operating property. While significant, these figures are misleading in that they make no allowance for varying rates of interest and dividends paid nor for widely differing depreciation charges. Allowing an eight per cent return on the estimated cost of each property, and depreciation at 2, 3, and 4 per cent, respectively, on underground, elevated and surface lines, the percentage of operating revenue necessary to meet the costs of capital and to insure the replacement of physical property is as shown in the last line of the table. Taxes are not included in this comparison because in one case the city owns a large part of the physical plant and in another it participates in the earnings. The heavy burden of subway and elevated lines is clearly

[1] Mere size of a city does not in itself necessarily justify the high expense of subway construction. In London, where subways were begun fifty years ago, they are only just now making a return upon the capital invested. In Chicago, with a population of about 2,500,000, subways have not been attempted * * *. The financial success of the New York subway is not due entirely to the size of the city, but to its geographical conditions and the distribution of the residential, commercial and amusement centers. An important factor is also the extensive suburban residence districts entirely outside of New York City from which a large daily commutation traffic is delivered to the subway for local distribution. — Barclay Parsons and Klapp, *Report on Detroit Street Railway, Traffic and Proposed Subway* — (Jan. 1915) p. 19.

TABLE CXVII — STATISTICAL DATA — RAPID TRANSIT AND SURFACE LINES

| | Year ended | Miles of line | Miles of track | Car miles | Car hours | Revenue passengers | Revenue passengers per mile of line | Revenue passengers per mile of track | Average speed | Revenue passengers per car mile | Car miles per mile of track |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rapid transit lines* | | | | (*Millions*) | (*Millions*) | (*Millions*) | (*Millions*) | (*Millions*) | (*Miles per hour*) | | (*Millions*) |
| New York Subways | 6/30/13 | 25.7 | 73 | 64.3 | 3.4 | 327.5 | 12.7 | 4.5 | 18.6 | 5.1 | 0.9 |
| New York Elevated | 6/30/13 | 37.7 | 90.7 | 66.1 | 4.4 | 306.8 | 8.1 | 3.4 | 15.0 | 4.6 | 0.7 |
| Chicago Elevated | 6/30/13 | 75.7 | 161.5 | 48.0 | 3.0 | 165.0 | 2.2 | 1.0 | 16.0 | 3.4 | 0.3 |
| Hudson and Manhattan | 6/30/13 | 7.9 | 16.5 | 7.7 | 0.4 | 58.9 | 7.5 | 3.6 | 18.1 | 7.6 | 0.5 |
| *Surface lines* | | | | | | | | | | | |
| New York Railways | 6/30/13 | 84.3 | 149.4 | 35.3 | 5.2 | 274.7 | 3.3 | 1.8 | 6.8 | 7.8 | 0.2 |
| Chicago Surface Lines | 1/31/13 | 388.6 | 777.1 | 99.4 | 11.0 | 572.5 | 1.5 | 0.7 | 9.0 | 5.8 | 0.1 |
| Cleveland Surface | 12/31/14 | 170.0 | 344.7 | 33.7 | 3.1 | 230.1 | 1.3 | 0.7 | 10.7 | 6.8 | 0.1 |
| 975 operating electric railways* | 12/31/12 | 30 438.0 | 41 033.0 | 1 921.6 | .......... | 9 545.5 | 0.3 | 0.2 | ........ | 5.0 | 0.05 |

* United States Census, 1912. Includes both Surface and Rapid Transit Lines.

Table CXVIII — Income Account — Subway, Elevated and Surface Lines, Year Ended June 30, 1913, Except as Shown

| | New York | | | | | | Hudson and Manhattan Railroad | |
|---|---|---|---|---|---|---|---|---|
| | Subway | | Elevated | | Railways | | | |
| | Amount | Per cent | Amount | Per cent | Amount | Per cent | Amount | Per cent |
| **Total operating revenue** | $16 807 955 | 100.00 | $15 689 916 | 100.00 | $14 065 159 | 100.00 | $3 692 818 | 100.00 |
| Passenger revenue | 16 352 766 | 97.29 | 15 331 593 | 97.72 | 13 605 853 | 96.73 | 3 448 390 | 93.38 |
| Other transportation revenue | 5 909 | .04 | 33 571 | .21 | .......... | ........ | 2 | ........ |
| Transportation Revenue | 16 358 675 | 97.33 | 15 365 164 | 97.93 | 13 605 853 | 96.73 | 3 448 392 | 93.38 |
| Other operating revenue | 449 280 | 2.67 | 324 752 | 2.07 | 459 306 | 3.27 | 244 426 | 6.62 |
| **Total operating expenses** | 6 644 405 | 39.53 | 6 616 338 | 42.17 | 8 146 252 | 57.92 | 1 361 206 | 36.86 |
| 1. Way and structures | 791 581 | 4.71 | 906 377 | 5.78 | 1 216 759 | 8.65 | 247 004 | 6.69 |
| 2. Equipment | 1 781 057 | 10.60 | 1 022 230 | 0.52 | 966 564 | 6.87 | 145 649 | 3.95 |
| 4. Power | .......... | ........ | .......... | ........ | .......... | ........ | .......... | ........ |
| Conducting transportation | 3 364 179 | 20.02 | 4 045 763 | 25.78 | 4 388 082 | 31.20 | 815 153 | 22.07 |
| 3 Traffic | 175 | .001 | 277 | .002 | .......... | ........ | 4 499 | .12 |
| 5. General and miscellaneous | 707 413 | 4.20 | 641 691 | 4.09 | 1 574 847 | 11.20 | 148 901 | 4.03 |
| **Net operating revenue** | 10 163 550 | 60.47 | 9 073 578 | 57.83 | 5 918 907 | 42.08 | 2 331 612 | 63.14 |
| Taxes | 389 405 | 2.32 | 1 727 475 | 11.01 | 1 169 895 | 8.32 | 232 288 | 6.29 |
| **Net after taxes** | 9 774 145 | 58.15 | 7 346 103 | 46.82 | 4 749 012 | 33.76 | 2 099 324 | 56.85 |
| Other income | 440 046 | 2.62 | 47 444 | .30 | 410 030 | 2.92 | 952 641 | 25.80 |
| Interest and rentals | 5 205 513 | 30.97 | 1 665 157 | 10.61 | 4 537 557 | 32.25 | 2 828 319 | 76.59 |
| Dividends | 4 200 000 | 24.99 | 4 200 000 | 26.77 | .......... | ........ | .......... | ........ |
| Deficit or surplus | 808 678 | 4.81 | 1 528 390 | 9.74 | 621 485 | 4.43 | 223 646 | 6.06 |
| Interest, dividends, rentals and surplus, less other income | .......... | 58.15 | .......... | 46.82 | .......... | 33.76 | .......... | 56.85 |
| Per cent of operating revenue necessary to cover depreciation and return | 62.47 | ........ | 35.05 | ........ | 29 86 | ........ | 270.78 | ........ |

| | Chicago | | | | Cleveland surface lines, year ended December 31, 1914 | | 975 operating electric railway companies, 1912 | |
|---|---|---|---|---|---|---|---|---|
| | Elevated | | Surface lines, year ended Jan. 31, 1913 | | | | | |
| | Amount | Per cent | Amount | Per cent | Amount | Per cent | Amount | Per cent |
| **Total operating revenue** | $8 834 662 | 100.00 | $29 173 589 | 100.00 | $7 692 343 | 100.00 | $567 511 704 | 100.00 |
| Passenger revenue | 8 477 843 | 95.96 | 28 547 919 | 97.86 | 7 482 506 | 97.27 | 502 651 637 | 88.57 |
| Other transportation revenue | 72 865 | .83 | 105 873 | .36 | 128 086 | 1.67 | 17 533 136 | 3.09 |
| Transportation Revenue | 8 550 708 | 96.79 | 28 653 792 | 98.22 | 7 610 592 | 98.94 | 520 184 773 | 91.66 |
| Other operating revenue | 283 954 | 3.21 | 519 797 | 1.78 | 81 751 | 1.06 | 47 326 931 | 8.34 |
| **Total operating expenses** | 4 537 604 | 51.36 | 17 369 963 | 59.53 | 5 879 675 | 76.44 | 332 896 356 | 58.66 |
| 1. Way and structures | 255 489 | 2.89 | 2 230 568 | 7.65 | 1 158 862 | 15.06 | 46 305 883 | 8.16 |
| 2. Equipment | 397 274 | 4.49 | 2 398 317 | 8.22 | 769 575 | 10.00 | 39 980 852 | 7.05 |
| 4. Power | .......... | ........ | .......... | ........ | 728 227 | 9.48 | ............ | ........ |
| Conducting transportation | 3 432 433 | 38.86 | 10 641 315 | 36.47 | 2 407 000 | 31.29 | 189 717 635 | 33.43 |
| 3 Traffic | 10 681 | .12 | 7 307 | .02 | 898 | .01 | 2 696 460 | .47 |
| 5. General and miscellaneous | 441 727 | 5.00 | 2 092 456 | 7.17 | 815 113 | 10.60 | 54 195 526 | 9.55 |
| **Net operating revenue** | 4 297 058 | 48.54 | 11 803 626 | 40.46 | 1 812 668 | 23.56 | 234 615 348 | 41.34 |
| Taxes | 716 270 | 8.11 | 1 236 925 | 4.24 | 466 996 | 6.07 | 35 027 965 | 6.17 |
| **Net after taxes** | 3 580 788 | 40.53 | 10 566 701 | 36.22 | 1 345 672 | 17.49 | 199 587 383 | 35.17 |
| Other income | 669 414 | 7.58 | 147 169 | .50 | 43 334 | .56 | 18 418 813 | 3.25 |
| Interest and rentals | 3 521 391 | 39.86 | 6 074 574 | 20.82 | 1 702 260 | 22.13 | 156 095 443 | 27.51 |
| Dividends | 1 098 574 | 12.43 | 4 599 986 | 15.77 | .......... | ........ | 51 650 117 | 9.10 |
| Deficit or surplus | *D* *369 763* | *D* *4.18* | 39 310 | .13 | *D* *313 254* | *D* *4.08* | 10 260 636 | 1.81 |
| Interest, dividends, rentals and surplus, less other income | .......... | 40.53 | .......... | 36.22 | .......... | 17.49 | ............ | 35.17 |
| Per cent of operating revenue necessary to cover depreciation and return | 78.44 | ........ | 40.03 | ........ | 51.40 | ........ | ............ | ........ |

indicated. Some advantage is observed in the variable costs of operation of these high speed lines, due to the density of traffic and the freedom from the expensive complications inherent in surface operation.

Following methods outlined in previous chapters, the cost of operation has been analyzed and the results are collected and shown in Table CXIX. From this table and from Fig. 46, it is evident that there are but few regions of sufficient traffic density to permit the construction and operation of either subways or elevated roads.

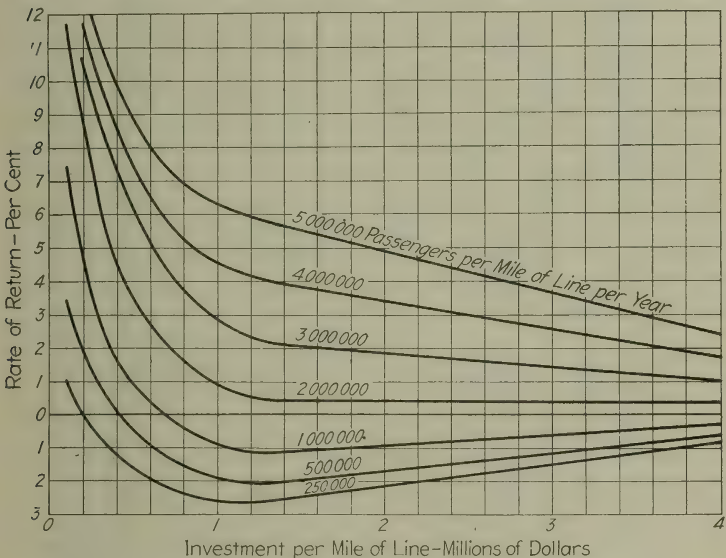



FIG. 46.— RELATION BETWEEN TRAFFIC DENSITY, INVESTMENT, AND RATE OF RETURN.[1]

The last line of Table VII gives the number of passengers per mile of line per year necessary to make the operation of each of the several types of transportation systems a feasible business venture. For example, if the number of passengers per mile of line per year necessary to make the operation of a subway possible were to stand closely, that is, but three feet apart, they would form a line 7 445 miles in length and the number of car miles necessary to care for this traffic would, if made by a single car, be equivalent to more than four round trips between the earth and the moon.

Fig. 46 represents the data in Table CXIX, the curves having been smoothed to eliminate minor variations from the trend, and indicates that for an investment of $1 000 000 per mile of line at least 5 000 000

[1] Conditions of density of traffic and investment are but rarely found which will indicate a rate of return for surface lines greatly in excess of 5 per cent.

TABLE CXIX — TERMINAL AND MOVEMENT COSTS — SUBWAY, ELEVATED AND SURFACE LINES

| ITEM | Rapid Transit Lines | | | Surface Lines | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | Cleveland | |
| | New York Subway | New York Elevated | Chicago Elevated | New York | Chicago | 5-cent fare | 3.25-cent fare |
| Costs exclusive of return on investment: | | | | | | | |
| Independent of extent of traffic — dollars per mile of line | 41 140 | 40 006 | 12 503 | 17 766 | 6 128 | 7 593 | 7 593 |
| [1] Varying with extent of traffic — cents per passenger mile | 0.378 | 0.536 | 0 605 | 0.915 | 0.580 | 0.749 | 0.749 |
| Varying with extent of traffic — cents per passenger | 2.195 | 2.683 | 3.629 | 3.329 | 3.104 | 2.741 | 2.741 |
| Rate of return with assumed traffic densities and five-cent fare: | *(Per cent)* | *(Per cent)* | *(Per cent)* | *(Per cent)* | *(Per cent)* | *(Per cent)* | *(Per cent)* |
| 250 000 passengers per mile of line per year | *D 0.83* | *D 2.57* | *D 1.08* | *D 3.27* | *D 0.56* | *D 0.98* | *D 3.19* |
| 500 000 passengers per mile of line per year | *D 0.66* | *D 2.11* | 0.60 | *D 2.27* | 1.34 | 1.87 | *2.55* |
| 1 000 000 passengers per mile of line per year | *D 0.32* | *D 1.28* | 0.12 | *D 0.25* | 5.12 | 7.57 | *1.27* |
| 2 500 000 passengers per mile of line per year | 0.71 | 1.35 | 2.62 | 5.78 | 16.51 | 24.69 | 2.59 |
| 5 000 000 passengers per mile of line per year | 2.43 | 5.73 | 6.75 | .......... | .......... | .......... | .......... |
| Number of passengers per mile of line required to yield 8 per cent return on cost[2] | 13 103 000 | 6 301 000 | 5 755 000 | 3 050 000 | 1 378 000 | 1 037 000 | 4 603 000 |

[1] Based on present average length of ride. D = deficit.

[2] Cost estimated from available records as accurately as possible in view of the facts of joint operation and joint ownership.

passengers per mile of line per year are needed to give a return of about 6.5 per cent. With the same investment and 1 000 000 passengers per mile of line per year, operation would result in a deficit. As yet, but few cities have reached even this density of traffic.

Elevated railroads, necessitating less investment than subways, are more frequently contemplated. The following paragraphs will deal therefore more particularly with this form of rapid transit.

It will be of interest to examine somewhat in detail the possibilities of the operation of an elevated railroad in competition with already existing surface lines. It is proposed to construct 24 miles of elevated railway in three double track divisions, each division having in addition an express track four miles in length. The total miles of track will, therefore, be 60 and the cost will be assumed to be in the neighborhood of $30 000 000. Allowing a minimum of seven per cent return on investment, together with three per cent for depreciation and renewals, there will be required $3 000 000 annually to meet these costs. With an average of 30 passenger miles per car mile, which is a considerably greater number than would likely be had, at least during the early years of operation if a schedule sufficiently frequent to develop business were maintained, and assuming further an average ride of five miles, it is possible to determine the number of five-cent fares necessary to meet the fixed and variable costs of operation.

From an examination of certain elevated railways now in operation, it appears that the costs to be expected may be estimated as follows:

Table CXX — Unit Costs — Elevated Railway

| ITEM | Unit Cost |
|---|---|
| Costs varying with the car mile | $0.03 |
| Costs varying with the car hour | 0.45 |
| Costs varying with the passenger | 0.003 |
| Costs varying with the track mile | 7 500 |
| Costs of electrical energy per car mile | 0.02 |

General administrative and overhead expense, including taxes, 42.5 per cent of the above costs.

Applying these unit costs to the conditions of operation as outlined above, the results shown in Table CXXI are obtained.

From Table CXXI it appears that it will be necessary to collect about 142 000 000 five-cent fares per year. Each of the three 8 mile divisions of the assumed elevated railway will be required to furnish about 48 000 000 fares per year. Practically no riding will occur locally within the first two miles at the downtown terminal end of the line. This leaves six miles of line which will therefore be under the necessity of producing an average of 8 000 000 fares each, per year.

In New York City, the rides per capita on the elevated system amount to about 100 per year and on the Chicago elevated, the per capita riding is about 80 per year for the city as a whole. In New York, the elevated is in competition with the subway and to a lesser extent with the surface lines, while in Chicago with surface lines only, with the exception of a small amount of traffic which is tributary both to the elevated lines and the suburban service of steam roads. If the proposed elevated system under consideration were to be entirely free from competition, it could quite likely depend upon something over 200 rides per capita per year from its tributary population. Inasmuch, however, as there is assumed to be already in existence surface electric transportation, it is not likely that the elevated lines can expect more than 100 to 125 rides per capita per annum from their tributary population. Of interest in this connection is Table CXXII which gives in detail the number of rides per capita in Greater New York. On the above basis, it is apparent that approx-

TABLE CXXI — COST OF OPERATING ELEVATED RAILWAY

| NUMBER OF UNITS | Unit cost | Amount |
|---|---|---|
| 24 000 000 car miles | $0.03 | $720 000 |
| 1 800 000 car hours | 0.45 | 810 000 |
| 142 000 000 passengers | 0.003 | 426 000 |
| 60 miles of track | 7 500 | 450 000 |
| 24 000 000 car miles — electrical energy | 0.02 | 480 000 |
| Total | .......... | $2 886 000 |
| General administrative and overhead expense, including taxes, 42.5 per cent of the above costs | .......... | 1 226 550 |
| Fixed charges | .......... | 3 000 000 |
| GRAND TOTAL | .......... | $7 112 550 |

TABLE CXXII — RIDES PER CAPITA — GREATER NEW YORK (Year Ended June 30, 1913 [1])

| NAME OF LINE | Rides per capita |
|---|---|
| **All lines — total** | 339.0 |
| **Surface lines — total** | 172.6 |
| Manhattan and The Bronx | 94.6 |
| Brooklyn and Queens | 75.4 |
| Richmond | 2.6 |
| **Elevated lines — total** | 92.4 |
| Manhattan and The Bronx | 58.8 |
| Brooklyn | 33.6 |
| **Subways — totals** | 74.0 |
| Interborough | 62.7 |
| Hudson and Manhattan | 11.3 |

[1] Report — Public Service Commission for the First District, New York — 1913, Vol. II, p. 28.

imately 400 000 people must live in the neighborhood of the outer six miles of the eight mile line, or approximately 65 000 people per mile of line. No very great part of the patronage of the elevated lines will consist of passengers going to elevated stations on surface lines, so that the 65 000 people tributary to each mile of track will, if the maximum walking distance is taken to be one-half mile, live within a square mile. This is, of course, a degree of congestion of population very rarely reached and indicates that only in exceptional cases is it possible to add elevated railway transportation to existing surface lines. This, of course, does not refer to the removal of surface traffic either to subways or elevated structures within certain congested districts, which method has a number of advantages, the principal one of which is that the point of grade separation may be moved out from the center of traffic from time to time, as traffic density grows.

In conclusion, it should be pointed out that while the costs of rapid transit by elevated and subway lines are so high as to render such transportation out of the question in most communities, there may nevertheless be much done to increase the service rendered by surface lines. The advantage of skip-stops appears not to have been generally fully realized. When the designated stops are established with a view to the accommodation of the largest number of passengers, through the elimination of stops at which normally few passengers begin or terminate their journeys, it is quite possible to increase the average speed of cars by 15 to 20 per cent while eliminating only half of the original stops.

In one city in the United States where the elimination of stops has been given a careful trial the average speed is eleven miles per hour. This is an increase of about two miles per hour since the elimination of 36 per cent of the stopping places at the less important traffic points.

The most rapid urban transportation is that furnished by the Subway Division of the Interborough (New York) on which the average speed is 18.6 miles per hour. The elevated lines in New York City are operated at an average speed of 15 miles per hour and those in Chicago at about 16 miles per hour. Table CXXIII shows the saving of time to the passenger brought about by transportation at these speeds for journeys of various lengths.

Table CXIII indicates a saving of five minutes for the average ride of three miles, if made on an elevated line. This will not be realized in general due to the greater headway on rapid transit lines operating trains of several cars, and the consequent greater average wait. Stations on elevated lines are a greater distance apart than are stops on surface lines, even when a considerable proportion of the latter are eliminated. This also tends to reduce the possible saving of time by increasing the length of walk both preceding and following the

ride. In so far as the saving in time is concerned, it is evident that the average patron of surface lines could not accomplish a great deal by the use of elevated lines.

Considering the total cost per passenger of transportation by elevated lines and by high speed (skip-stop) surface lines a consider-

TABLE CXXIII — TIME SAVED BY TRAVEL AT VARIOUS SPEEDS.

| LENGTH OF RIDE IN MILES | Subway | | Elevated | | | | Skip-stop surface 11 miles per hour |
|---|---|---|---|---|---|---|---|
| | 18.6 miles per hour | | 16 miles per hour | | 15 miles per hour | | |
| | Elapsed time | Saving over 11 miles per hour | Elapsed time | Saving over 11 miles per hour | Elapsed time | Saving over 11 miles per hour | Elapsed time |
| | (*Minutes*) | (*Minutes*) | (*Minutes*) | (*Minutes*) | (*Minutes*) | (*Minutes*) | (*Minutes*) |
| 1 | 3.2 | 2.3 | 3.8 | 1.7 | 4 | 1.5 | 5.5 |
| 2 | 6.4 | 4.5 | 7.5 | 3.4 | 8 | 2.9 | 10.9 |
| 3 | 9.7 | 6.7 | 11.3 | 5.1 | 12 | 4.4 | 16.4 |
| 4 | 12.9 | 8.9 | 15.0 | 6.8 | 16 | 5.8 | 21.8 |
| 5 | 16.1 | 11.2 | 18.8 | 8.5 | 20 | 7.3 | 27.3 |
| 6 | 19.3 | 13.5 | 22.5 | 10.3 | 24 | 8.8 | 32.8 |

able advantage in favor of the latter is disclosed. A part of these costs may be borne by the transportation company as wasting of property without the accumulation of reserves, or as a return on investment less than reasonable, by the community in the shape of taxes to make good operating deficits, or by the patrons as higher fares. In any case the costs can not be avoided, although they may be placed in part upon those who have not received the service and who have not occasioned them.

TABLE CXXIV — COSTS PER PASSENGER — ELEVATED AND SURFACE LINES (Seven Per Cent Return.)

| NUMBER OF PASSENGERS PER MILE OF LINE PER YEAR | Cents per passenger | |
|---|---|---|
| | Elevated railway | High-speed surface line |
| 250 000 | 26.67 | 8.28 |
| 500 000 | 14.56 | 5.51 |
| 750 000 | 10.19 | 4.58 |
| 1 000 000 | 8.50 | 4.13 |
| 1 500 000 | 6.47 | 3.66 |
| 2 000 000 | 5.47 | 3.43 |
| 2 500 000 | 4.86 | 3.29 |

Table CXXIV, giving cost in cents per passenger on elevated and surface lines, is based on the average costs developed in the preceding paragraphs.

The above table indicates that for a small number of passengers per mile of line per year the cost per passenger on elevated lines is several times that of high speed surface lines. However, with increased density of traffic the cost on the elevated decreases more rapidly than on the high speed surface lines. Thus for 2 500 000 passengers per mile of line per year the cost per passenger on the elevated is but 50 per cent greater than the corresponding cost of high speed surface line transportation. An increase of speed will, through its effect on costs, permit additional service either in regions already served or in outlying districts.

Careful attention on the part of traffic police will serve to increase materially the average speed of cars.

The establishment of loops and other track facilities for short-routing will likewise promote rapid transit at a decreased rather than at a greatly increased cost, as must be the case where independent rapid transit facilities such as subway or elevated lines are constructed.

The use of designated stops has but recently begun to receive the attention it deserves from the standpoint both of better service, through the shortening of the length of time required to complete a trip, and of economical operation. In a later chapter [1] there is discussed somewhat at length the advantages of the use of designated stops as practiced by the Cleveland Railway Company. In Cleveland, the elimination of less than 50 per cent of the stops increased the average length of walk to and from the car only about 150 feet and served to make an average scheduled speed of eleven miles per hour possible.

The problem of urban transportation has many phases in addition to that of cost, and while it can not be said with confidence that this or that factor will be of determining importance. in it is certain that costs must always be given careful consideration. Certain of the other factors have been discussed in Chapter XVIII — Cost of Competing Forms of Transportation — the conclusions of which [2] should be borne in mind in connection with the study of costs as outlined in the preceding paragraphs of this chapter and are here repeated.

" Within recent years there has been much discussion of city planning. Looking back upon the growth of American cities, architects and engineers have pointed out defects of development in the absence of a definite policy of expansion, which have resulted in untold loss of time, money and comfort. It is possible to ameliorate much of this condition by an intelligent city transportation policy which coordinates what are now competing forms of transportation, with a resulting

[1] Chapter XXIV.
[2] Page 310.

lower cost to the individual in sacrifice of time and money, and economy to the community in the operation of public highways. Suitable promenades for pedestrians, definite routes for motor trucks, speedways for automobiles and a cleared right-of-way for the street car with intelligent traffic rules well enforced, may do much to bring order and economy out of the chaos and duplication of facilities which are so common in American cities."

## PART V

### REGULATION AND THE COST OF SERVICE

# CHAPTER XXI.

## REGULATION AND THE COST OF SERVICE

Cost and Value of Service Theories,—— Considerations which have made Cost of Service a Controlling Question in Rate Regulation,—— The Cost of Service Theory and Efficient Management, —— Importance of Cost of Service in the Two Types of Regulation,—— Regulation by Contract and Continuous Regulation.

The question as to whether rates for public service should be based upon the cost of service or upon other factors, is one upon which many differences of opinion have been expressed, not only by economists but by courts and commissions. The customary charge and what the service is worth are usually referred to as important if not controlling tests of reasonable rates. It is not necessary to add further theoretical discussion to this controversial question.

There are several factors, however, which have made the cost of service of greater importance in urban street railway rates than in the rates of other public utilities. The first of these arises out of the nature of the street railway income. The urban street railway is almost entirely dependent for its livelihood upon a flat rate for service. Its maximum rates are practically its entire rate schedule. Its rates involve few questions as to the equitable distribution of charges as between different classes of customers. It has few opportunities, should it so desire, of discriminating between different patrons or as between different sections of the same community. Any proposed change in its basis of charges immediately raises the question as to the effect on income; or, in other words, the controlling consideration is the cost of service.

Unlike other utilities, also, the unit charge for service is so small that the difference of a fraction of a cent in the fare measures the difference between comparative affluence and confiscation. There appears to be no means of applying the value of the service, for example, to so small a scale of differences. This is well brought out in the recent decision by the Wisconsin Supreme Court, in Duluth Street Railway Company vs. Railroad Commission, 152 N. W. 887, in which Justice Barnes stated:

It is argued that there is very little connection between the profit which a party makes out of a service performed and what it is worth, and that in determining the value of a thing like railroad transportation the question is not whether the profit is large or small, but what is the service actually worth to the public. It is also argued that this element was lost sight of by the Commission, and that it based its idea of reasonableness solely on the amount of profit which plaintiff was making, and regardless of what the service performed was worth. The weakness of this test was, no doubt, apparent to counsel, because it was suggested, rather than pressed. If it were adopted, it would be extremely difficult for anyone to say that a

rate of 10 cents a mile for carrying passengers on our railroads was unreasonable. So it is contended that the market value of the service should be deemed the reasonable value of it rather than its worth, and that, inasmuch as a 5-cent fare is charged in most cities, this fact establishes market value. If this should be established as a guiding principle, it would be impossible to make any compulsory reductions in rates, no matter what economies might be practised in the transportation business. * * * The cost of the service is the most definite and tangible guide there is to tie to in making rates, if, indeed, it is not the only one. Where rates are so adjusted as to yield a fair return on the value of the property over and above expenses and depreciation, they are reasonable. Where they are so fixed as to materially exceed this sum, they are not.

Another reason for the prominence of cost of service in regulation of urban street railway rates rests in the fact that the issues involved have been confined largely to the question as to whether certain reductions in rates were not such as to make revenues less than the amount necessary to yield the traction company its cost of operation, the cost of replacement of physical property worn out, and the return necessary to attract capital into the business.[1] The issue involved has usually been whether certain regulations have not been confiscatory rather than whether certain rates have not been extortionate. The evidence underlying such a determination has necessitated an inquiry into the cost of service.

Very recently it appears that the United States Supreme Court has applied the question as to whether rate regulations were confiscatory, not to the business of a transportation company as a whole, but to

---

[1] See for example — "Five Commission Decisions," AERA, April, 1915, and Chapter VI, page 75.

The following excerpts represent more recent decisions: 1914 Report of the Massachusetts Public Service Commission, Vol. I.

In *re:* Increase in rates of fare by the Providence and Fall River Street Railway Co.— page 222.

> The Commission * * * is of opinion, in view of the financial condition of the company, that an increase in the rate of fare for local passengers on the Providence and Fall River Street Railway from five to six cents is justified * * *.

In H. B. Davis et al *vs.* the Brockton & Plymouth Street Railway — page 216.

> As the company has been unable from its present operating revenues to pay any dividends upon its common stock, and as further improvements in its service are demanded as soon as the financial conditions of the company will permit, the Commission would not be warranted in ordering the company at this time to reduce its unit of fare from six cents to five cents.

Again in the Railroad Passenger Rate Cases cited in P. U. R. 1915-B-362, the Massachusetts Public Service Commission found as follows:

> Broadly stated, rates should be so fixed as to yield to a railroad corporation economically and efficiently managed, revenue adequate to meet its operating expenses and fixed charges and to yield a fair return upon the capital honestly and prudently invested, rates which are either too low or too high, judged by this standard, being unjust and unreasonable, either to the company and its stockholders, or to the traveling public.
>
> The steadily increasing ratio of operating expenses to operating revenues of railroad companies, due to the general increases in the cost of fuel, labor and maintenance of way, structures, and equipment, was recognized in a determination of the reasonableness of proposed changes in railroad rates.

In Washington Public Service Commission *vs.* Puget Sound Traction, Light and Power Co., cited in P. U. R. 1915-B-800, the Commission found as follows:

> After a valuation of a street railway company's property an increase in rates will be ordered if the present rates are not sufficient to enable the company to provide adequate service and at the same time yield a reasonable return upon the investment.

particular rates. In the recent North Dakota Lignite Coal Company case, 236 U. S. 585, March 9, 1915, Justice Hughes concludes:

With respect to particular rates, it is recognized that there is a wide field of legislative discretion, permitting variety and classification, and hence the mere details of what appears to be a reasonable scheme of rates, or a tariff or schedule affording substantial compensation, are not subject to judicial review. But this legislative power cannot be regarded as being without limit. The constitutional guaranty protects the carrier from arbitrary action and from the appropriation of its property to public purposes outside the undertaking assumed; and where it is established that a commodity, or a class of traffic, has been segregated and a rate imposed which would compel the carrier to transport it for less than the proper cost of transportation, or virtually at cost and thus the carrier would be denied a reasonable reward for its service after taking into account the entire traffic to which the rate applies, it must be concluded that the state has exceeded its authority.

It is apparent that this doctrine has a far reaching application to rate regulations of street railways involving commutation tickets during rush-hours and fares to suburban points.

The danger in the application of the cost of service theory lies in the fact that it does not properly differentiate between what are efficient and inefficient costs. No less person than Louis D. Brandeis has stated before the Railway Securities Commission:

Today efficiency in management is in danger of being punished, whereas, it should be rewarded. Efficiency is naturally reflected in large net earnings; and as no ready means exist for determining whether greater net earnings are due to greater efficiency in management, or to higher rates, large earnings are frequently accepted as evidence that rates are too high, and invite a demand for reduction; whereas, in fact, the large earning may be due wholly to better judgment, greater efficiency, and economy in administration. To take from railroad corporations the natural fruits of efficiency — that is, greater money rewards — must create a sense of injustice suffered, which paralyzes effort, invites inefficiency, and produces slipshod management.

This conforms to the language of the Wisconsin Supreme Court, in the Duluth case previously cited, when it states that:

A company that is on the alert to practice economies should have some part of the saving, else there would be no inducement to reduce the cost of the service.

and is akin to the decision of the Wisconsin Railroad Commission, in City of Milwaukee *vs* The Milwaukee Electric Railway and Light Co., 10 W. R. C. R. 242, where the Commission states:

A feature of considerable importance is the rate of return to efficient management. In determining the return to the management some allowance should be made in some manner for special efficiency. To deny this is to take away one of the greatest incentives to economy.

At the present time interest in the cost of service centers about its methods of application under various types of regulation rather

than about the development of the theory. During the twenty years prior to 1907, regulation of urban railways was almost entirely by franchise provisions. To use public streets, it was necessary first to secure permission from the city and in return for this permission the railways accepted certain regulatory obligations imposed by the city. These obligations have covered a wide range and have concerned themselves with rates of fare, transfers, car licenses, paving construction and maintenance, and the cleaning and sprinkling of streets. Provisions whereby the city would share in the net earnings were made a part of franchises granted in Philadelphia and Chicago. In New York and Boston, the construction of subways was furthered with public funds and the property so created leased to the railways for private operation. In Cleveland, the service is prescribed by the city and the rate of fare has varied in an attempt to keep the profitableness of operation reasonably constant.

Since 1907, a number of states have placed the regulation of their urban railways under boards or commissions with ample powers and exercising state-wide jurisdiction. The general scheme of state regulation is to fix rates and service from time to time in the light of the situation as it then exists.

Regulation by contract — that is, under provisions contained in franchises — has its most conspicuous example in the case of The Cleveland Railway Co. Regulation by the continuing supervision of a state commission is well illustrated in the case of The Milwaukee Electric Railway and Light Co., whose service and rates of fare have been under the jurisdiction of the Railroad Commission of Wisconsin since 1907.

There has been some question as to which type of regulation has produced the best results. Due to imperfections in both plans as now applied, it is probable that no satisfactory answer can be given to this question. It will be of service, however, to examine the part cost of service has played in typical instances of regulation by contract and of continuous regulation by commission. A description of the concrete difficulties in each case will probably serve a better purpose than a more extended general discussion.

In succeeding chapters the situations in Cleveland and Milwaukee have been examined into with some care, as respective types of the two kinds of regulation. In both instances practically every problem of operation has been regulated, and the cost of service has been an important consideration. The studies are confined to cost problems and only so much of the legal questions involved and local conditions surrounding operation have been added as will assist in an understanding of the case.

## CHAPTER XXII

### THE CLEVELAND EXPERIMENT — EVENTS PRECEDING THE TAYLER ORDINANCE

First Proposals of Tom L. Johnson in 1903,—— Results of Trial of 3-Cent and 4-Cent Fares,—— Status of Competitive Franchises in the Courts,—— The Holding Company Plan,—— Rejection of Proposals for Renewal of Existing Franchises after Arbitration,—— Joint Use by Competing Companies of Track to Public Square,——Abandonment of Central Avenue Line,—— The Curative Ordinance,—— Mayoralty Campaign of 1907,—— Further Efforts for a Holding Company,—— Neutral Railway Company, —— The Security Franchise,—— Lease of Property to Municipal Traction Company,—— The Beginning of 3-Cent Fare,—— The Schmidt Street Railway Law,—— Defeat of Security Franchise on Referendum,—— Receivership of Municipal Traction Company, —— Increase in Fares under Receivership,—— Preliminary Proposals for a Settlement Franchise,—— More Efforts at Competition,——Arbitration,—— The Mayoralty Campaign of 1909,—— Decision of Judge Tayler.

A study of the advantages and defects of the plan of regulation by the municipality, based on contract as operating in Cleveland, would not be complete without a resumé of the events preceding the adoption of such a plan. The so-called Tayler ordinance under which the rates of fare in Cleveland tend to be automatically regulated to conform to the cost of service, was evolved after a series of experiments, proposals and counter-proposals which preceded its enactment.

These various developments are set forth chronologically in this chapter, without comment as to their effects upon the financial status of the companies involved, upon the service rendered the patrons of the companies, or upon the fortunes of those who very obviously made the traction situation in Cleveland a political issue.

In 1903, Tom L. Johnson,[1] a sometime Brooklyn, N. Y., and Detroit, Mich., street railway promoter, was re-elected Mayor of Cleveland, upon a platform pledging the establishment of competing 3-cent fare railways, the prevention of the passage of ordinances extending existing franchises without granting 3-cent fares and universal transfers, together with possible municipal ownership. Immediately after his election he started a second campaign for the establishment of 3-cent fare lines in Cleveland. In August of the same year, the Cleveland Electric Railway Co. made application for additional franchises to provide extensions to its street railway lines and for extensions of existing franchises, some of which were about to expire. In return for the extension of existing franchises, Mayor Johnson in 1904 demanded a 3-cent fare, from the Cleveland Electric Railway Co.

[1] Mr. Johnson had also been interested prior to this time in the promotion and operation of electric railway properties in Louisville, Ky., Indianapolis, Ind., St. Louis, Mo., and Cleveland, Ohio.

Early in January, 1905, in an open letter to the Company, the Mayor appealed for a trial of his 3-cent fare idea on one or more lines or within a radius that would take in the most densely populated sections of the city.

On January 23, 1905, the company began to operate special cars bearing large signs "Three Cent Fare: No Transfers" on twenty routes, about 2.5 miles each in length. The experiment did not interfere with the system of operation of the regular cars and the charge of 5-cents cash with free transfer was continued as before. The 3-cent scheme was abandoned February 4, 1905, after two weeks' trial, having caused considerable financial loss and complaints of congestion in the center of the city. On February 6, 1905, a 4-cent cash fare scheme without transfer was substituted, the regular ticket (11 for 50 cents) or a 5-cent cash fare being accepted as fare with transfer privilege. On February 15, 1905, President Andrews of the Company, in a letter to the City Council, made public the results of the 3-cent and 4-cent fare experiments and pointed out that the adoption of either would involve so great a reduction in earnings of the company as to prove disastrous.

In the same month various decisions affecting the franchises of the Cleveland Electric Railway Co. were handed down by the Federal Courts. Judge F. J. Wing in the United States Circuit Court made permanent an injunction prohibiting the Forest City Street Railway Co., a competing road, or the city from taking possession of certain routes for 3-cent fare lines. The Forest City Street Railway Co. had been granted a franchise over these routes to start September 20, 1904, the date Mayor Johnson and the city administration claimed the franchise of the Cleveland Electric Railway Co. had expired. This decision held that the franchise in question did not expire until February 10, 1908. Another decision by Judge Tayler, of the United States Circuit Court, held that the franchise of the Cleveland Electric Railway on another route (Central Avenue) had expired March 22, 1905, but that the city could not grant a renewal franchise to a new company and that the Forest City Company could not enjoy the franchise granted it by taking over the property of the Cleveland Electric Railway. Prior to these decisions, President Andrews stated that his Company stood ready, no matter what the decision of the courts might be, to surrender all its present rights whether perpetual or limited, in return for a new limited contract covering all the lines. He further requested that the Chamber of Commerce or some other nonpolitical body, take up the franchise question and propose an equitable basis for settlement.

During April and May, 1905, counter proposals of settlement were made by the Mayor and the Company. The Mayor's plan provided for the lease of the railway to a holding or trust company, in exchange for a guaranteed dividend to the present owners, such lease to terminate at any time the city should choose to buy the property, assuming that

proper authority were given it, so to do, by the State. The company proposed two plans. The first provided for a 5-cent fare, 6-tickets for 25 cents, free transfers and the payment to the city of one-half of the net income over and above fixed charges and a 5 per cent dividend on capital stock, including such new capital as might be invested from time to time; the second substituted for the dividend proposition 8 tickets for 25 cents and free transfers during one hour of heaviest traffic in the morning and evening. The Cleveland Chamber of Commerce appointed in November, 1905, a committee of prominent business men to study the street railway problem, and the report of this committee was adopted in April, 1906. The report condemned the plans for municipal ownership and of a holding company as proposed by Mayor Johnson and suggested a reduction of fares with shorter hauls. In brief, it advised the sale of 3 tickets for 10 cents, 15 for 50 cents and 30 for $1.00, for straight fares without transfers; 5 cents for cash fare for a ride with transfer; the shortening of the length of haul on the low fare tickets; the removal of bridge taxes and car licenses; the retention of paving, cleaning and sprinkling ordinances; and in return for these concessions it recommended the granting of a new 25 year franchise for the entire traction system.

By a decision of the Supreme Court of the United States in April 1906, the expiration of certain franchises (Woodland Avenue) was fixed at 1908. In effect this decision limited the operations of the Forest City Street Railway Co., charging a 3-cent fare, to the west side streets upon which it obtained franchises on open bid.

In a communication to the City Council on July 24, 1906, the Cleveland Electric Railway Co. proposed a renewal of the franchises on the basis of a material reduction in fares (7 tickets for 25 cents); concessions in the matter of transfers; certain extensions; two new crosstown lines and the building of an East End subway to relieve congestion. The company further proposed to submit the entire proposition to the vote of the people at the next general election, if the council was in doubt as to the public sentiment on the question.

In August, 1906, the ordinance proposed by the company was amended to contain a clause giving the city the right to purchase the property at the expiration of the franchise term, providing the law at that time was such as to give it the authority to own and operate street railways, and shortening the term of the franchise by five years, making it 20 instead of 25 years, as originally proposed. As a result of the Mayor's efforts, the Council in September postponed indefinitely any action on this proposition.

During the latter part of 1906, and while these negotiations were in progress, the activities of the Forest City Street Railway Co. and the Municipal Traction Co., which had acquired by lease the property and franchises of the Forest City Railway Co., were directed toward securing rights-of-way to the Public Square. Injunctional suits to prevent the laying of tracks, surreptitious attempts to secure pos-

session of the streets, suits to declare the franchises of the Forest City Street Railway Co. void, because of alleged financial interest of Mayor Johnson in that road, and the fining of municipal officials for contempt were incidents of these efforts. An agreement was finally reached whereby the Forest City Street Railway Co. was temporarily given the right to operate over the Cleveland Electric Railway Company's tracks in order to reach the Public Square.

About the middle of January, 1907, a 30-day truce was finally called and negotiations were opened, looking toward the termination of the Cleveland Company's occupancy of the streets on which its franchises had expired. Several meetings of the City Council were held and proposals towards settling the controversy were submitted by the Cleveland Electric Railway Co., the Municipal Traction Co. and the recently organized Low Fare Railway Co.[1] The holding company plan was again revived, this time by the Municipal Traction Co. Numerous conferences were held between President A. B. duPont of the Municipal Traction Co. and President Andrews of the Cleveland Electric Railway Co. and attempts were made to arrive at a fair valuation of the property. On March 25, 1907, both Presidents reported to the City Council that they were unable to reach an agreement. The Cleveland Electric Railway Co. then declared its willingness to submit the matter to arbitration. No further action was taken on this proposition.

Late in April, 1907, the Cleveland Electric Railway Co. notified the City Council that service on the Central Avenue and Quincy Street lines would be abandoned. These lines had been operated upon a 3-cent fare basis since the decision of the Supreme Court, declaring

---

[1] The corporate history of these separate companies was as follows:

The Cleveland Electric Railway Co. was incorporated February 26, 1893, for the purpose of operating street railways in the City of Cleveland. It absorbed the East Cleveland, The Brooklyn, The Broadway & Newburg, and the South Side Railroad Cos. In 1903, it purchased all of the property and rights of the Cleveland City Railway Co., which represented at that time a consolidation of the Woodland Avenue and West Side Street Railroad and the Cleveland City Cable Railway Co. In 1906, the Cleveland Tramways Co. was incorporated by interests identified with the Cleveland Electric Railway Co., for the purpose of bidding for franchises on certain streets upon which the Cleveland Electric Railway Company's franchises were to expire. This latter company apparently never engaged in the electric railway business.

The Forest City Street Railway Co., a successor to the Peoples Street Railway Co., was incorporated October 6, 1903. The Forest City Street Railway Company's franchise purported to give that company a right to build from the Public Square to West 25th Street and Lorain Avenue. The total length of track constructed or authorized was about 13 miles.

The Municipal Traction Co. was incorporated in June, 1905, and took over on January 1, 1907, the operation of the Forest City Street Railway Co. under lease. The purpose of the incorporation of the Municipal Traction Co. as stated by Mayor Johnson was that of acting as an intermediary between the people and the Street Railway company.

The Low Fare Railway Co. was incorporated in December, 1906, with a capital stock of $250,000. The names of W. B. Colver, Secretary of the Municipal Traction Company; W. H. Greenlund, I. D. George, J. E. Creed and J. C. Harding appear in the incorporation papers. The general opinion was that this company was formed to protect and succeed to the rights of the Forest City Street Railway Co. and that all future grants would be made to it.

The Neutral Railway Co. was incorporated in April, 1908, for the purpose of relaying track on Central Avenue and Quincy Street.

On April 27, 1908, the Cleveland Electric Railway Co. absorbed the Forest City Street Railway Co., that company having previously absorbed the Low Fare Railway Co., and on the same date, the combined property (now known as The Cleveland Railway Company) was leased to the Municipal Traction Co.

that these franchises had expired, pending the settlement of the franchise question. The Company stated its willingness to sell the property on these streets to any purchaser at a fair figure. An offer was made by the Forest City Street Railway Co., but was rejected as too low. Orders by the City Council to remove the tracks from the streets and conflicting orders by the Mayor to the police to prevent the removal of the property that the new companies might take possession of the tracks on the ground of public expediency then ensued. Injunctions, petitions and conflicting franchises and rights of the Low Fare Railway Co. and the Forest City Street Railway Co. served to complicate the situation. Finally in August, 1907, the City Council passed a "curative" ordinance re-enacting all the grants formerly made to the Forest City Street Railway Co. and allowing it the joint use of the Cleveland Electric Railway Company's tracks, in certain places. It was claimed that Mayor Johnson was no longer interested in the Forest City Street Railway Co. and that there was now nothing to make the grants to the company by the city illegal. The Cleveland Electric Railway Co. at once filed a request with City Solicitor Baker[1] to bring injunction proceedings against the execution of the ordinance, stating eleven reasons why the suit should be brought in behalf of the city. Upon Solicitor Baker's refusal so to do, the Cleveland Electric Railway Co. then brought injunction suits upon its own account. Upon trial before Judge Lawrence, these suits were decided against the Forest City Street Railway Co. though its franchises on the west side of the city were upheld.

The mayoralty campaign of 1907 resolved itself into a fight over the street railway situation, Mayor Johnson's platform comprising his "3 cents within the city" or zone plan and his opponent, Burton, advocating a "7 tickets for 25 cents" policy. In connection with this campaign, City Clerk Witt[2] attacked and sought to enjoin as a stockholder the Cleveland Electric Railway Company's publicity campaign, and just before the election, the City Council passed five ordinances giving the low-fare companies the right to use the tracks of the Cleveland Company in the so-called "free territory" and thus enabled the Forest City Street Railway Co. to operate around the Public Square. After the re-election of Mayor Johnson, the Cleveland Company offered to give a six months' trial to 3-cent fares and accept a 25-year franchise and any fare determined by a disinterested board of experts to yield it a return of 6 per cent upon the value of its property. The proposition was rejected by Mayor Johnson, who once more revived the "holding company" plan.

Finally, December 4, 1907, the "holding company" plan proposed by Mayor Johnson, was agreed upon and F. H. Goff was appointed to represent the Cleveland Electric Railway Co. in the negotiations. The valuation of the physical property was made by Presidents An-

---

[1] Elected Mayor of Cleveland, November, 1911.

[2] Appointed City Street Railroad Commissioner by Mayor Baker, January, 1912.

drews and duPont, aided by a corps of experts, while City Solicitor Baker and Mr. Tolles (Mr. Goff's law partner) were chosen to settle the problem of unexpired franchises.

In April, 1908, Mr. duPont and Mr. Goff financed the Neutral Railway Co. which built tracks on Central Avenue and Quincy Street with the intention of allowing the competing companies to operate jointly on these streets. At the same time, the Ohio Legislature enacted the Schmidt Street Railway Bill, providing for the renewal of old franchises to new companies. This law was enacted to offset the supreme court decision providing that a new company must secure the consents of a majority of the property holders along the line. The City Council thereupon granted the Forest City Street Railway Co., under suspension of the rules, franchises on Woodland avenue and the greater part of the west side of the city then served by the Cleveland Electric Railway Co.

In the latter part of April, 1908, Mayor Johnson and Mr. Goff finally reached a basis of settlement. The stockholders sanctioned the agreement, the name of the Cleveland Electric Railway Company was changed to The Cleveland Railway Company, all pending suits were dismissed, all papers were placed in the joint custody of Mayor Johnson and Mr. Goff, and the City Council, enacted the "security" franchise by a vote of 28 to 4. The "security" franchise extended the rights of The Cleveland Railway Co., in the streets then occupied by its lines, for 25 years at a fare of 5-cents or 6-tickets for 25 cents. The Municipal Traction Company with Mayor Johnson and Mr. Goff as directors, became lessee of all the traction property and guaranteed The Cleveland Railway Co. a 6 per cent dividend on its capital stock. Within a day, a straight 3-cent fare went into operation on all lines with an additional charge of 1-cent for transfers. The fare to the suburbs remained 5 cents or 11-tickets for 50 cents. On July 28, 1908, a new transfer plan, retaining the 1-cent charge but providing for a refund at time of presentation of the transfer for passage, was adopted. Other innovations designed to effect a reduction in the operating expenses followed. The noticeable reduction in car miles and the attendant reduction in service, caused considerable public complaint.

Dissatisfaction by suburban patrons and labor troubles caused the circulation of petitions to refer the newly enacted "security" franchise to a referendum vote under the Schmidt Street Railway Law, and on September 5, 1908, the City Council, at a special session, passed a resolution authorizing the Mayor to set October 22, 1908, as the date for a referendum vote. A vigorous campaign against the franchise was at once begun, and on October 22, 1908, the voters of Cleveland disapproved, by a majority of 605, the "security" franchise granted to The Cleveland Railway Co., at the time the property was leased to the Municipal Traction Co.

Immediately thereafter, a petition was filed in the United States

Circuit Court, asking for a receiver for the Municipal Traction Co., which had defaulted on its rental payments. The receivership proceedings were bitterly contested by Mayor Johnson and caused the resignation of Mr. Goff from the Board of Directors of the Municipal Traction Co. According to the terms of the lease, the appointment of a receiver would have caused the property to revert to The Cleveland Railway Co. Hearings were held before Judge Tayler, of the United States Circuit Court, November 2, 1908, and on November 12, 1908, Warren Bicknell, President of the Cleveland Construction Co. and F. A. Scott, Secretary and Treasurer of the Superior Savings & Trust Co. of Cleveland were named as receivers of the Municipal Traction Co. and the property of The Cleveland Railway Co. Before naming the receivers Judge Tayler obtained from The Cleveland Railway Co. a waiver of any claim to a forfeiture of the lease by virtue of the receivership. The receivers at once took possession of the property to manage and operate the same, subject to the orders of the Court.

In January, 1909, the receivers conferred with Judge Tayler and Mayor Johnson upon a possible increase in fares. The Mayor criticised the service as extravagant and again asserted that a 3-cent fare with a 1-cent charge for transfers during the winter months was sufficient. The receivers insisted that a 3-cent rate of fare would not pay the cost of adequate service, and then applied to the City Council for a short term grant at the rate of 6-tickets for 25 cents or a cash fare of 5 cents. This application was followed by the filing of a motion by creditors in the United States Circuit Court asking that the receiver be instructed to charge the fares provided for in the franchises granted to the several companies included in The Cleveland Railway Co. On January 27, 1909, Judge Tayler ordered the receivers to charge the maximum fares provided in the franchises of the constituent companies, as granted by the city. Under the new arrangement 5-cent fares were charged on some lines and 3-cent fares on others. In either case, the fare to the suburbs was 5 cents. Refund transfers were continued.[1]

At the suggestion[2] of Judge Tayler to the receivers, Mayor

---

[1] Financial results of operation of The Cleveland Railway Co. by receivers are given in the *Electric Railway Journal* for February 27, 1909.

[2] The proposal of Judge Tayler of a franchise with rates based on the cost of service, read in part as follows:

The early expiration of some ordinances and the comparatively short life of the longest of the 5-cent ordinances makes it absolutely necessary for you to earn more money from operation than if there was a long time franchise. The public burden thus imposed during the life of these short time franchises can only be avoided, and can now and for all time be avoided by the immediate passage of an ordinance, which, while allowing a rate of fare which will permit the raising of money for improvements and extensions in accordance with sound business principles, will by its fixed and certain provisions, make sure and effective contract between the city and the owners of the property that no more shall be charged than the service actually costs. In other words, an ordinance embracing all of the so-called security grant, but containing in addition the vital and distinguishing features and made so by valid contract.

1. The limitation of fare to the actual cost of service, including in this, of course, 6 per cent and no more on the stock and values which have not passed into stock, and interest on the bonds; and
2. A system of accounting and inspection, in which the city has the right so far to participate as to make certain that only this cost of service is charged.

Johnson appointed a committee consisting of himself, Judge Tayler, Attorney J. G. White (The Cleveland Co.), City Solicitor N. D. Baker, F. H. Goff and Attorney D. C. Westenhaven (Municipal Traction Co.) to consider the question of granting a long time franchise to the Cleveland railway system.

After numerous conferences and meetings, the City Council rejected a tentative ordinance prepared by Judge Tayler, embodying the following features:

1. Maximum rate of fare: 7-tickets for 25-cents, 1-cent for transfer with no rebate and 5-cents for single cash fare.
2. Initial fare: 3-cents and 1-cent for transfer with no rebate.
3. Valuation to be determined:
   (*a*) by taking Johnson-Goff valuation.
   (*b*) by an expert impartial arbitration.
4. Supervision by city of accounting and operation.
5. The right of the City Council to nominate a purchaser, this right to be exercised not earlier than 10 years from date of grant.
6. Submission of whatever ordinance was passed to the people at a referendum election.

On June 4, 1909, the Council passed and Mayor Johnson signed the Baker ordinance granting The Cleveland Railway Co. a franchise for 25 years and providing, among other things, for the following:

1. Maximum fare: 4-cents cash and 7-tickets for 25-cents with no charge for transfers.
2. Revaluation of properties of Cleveland Electric Railway and Forest City Street Railway separately.
3. Arbitration of disputes by board consisting of one company representative, one city representative and of Judge Tayler in case the two failed to agree.
4. The right of city to nominate a purchaser for the property to be exercised at any time after January 1, 1913.
5. Control of operation by city.
6. Appointment of a street railway commissioner to be paid by the Company.

This ordinance was rejected by The Cleveland Railway Co. and the City Council thereupon passed an ordinance giving Herman Schmidt a franchise grant on Payne Avenue. A franchise was likewise granted to the Cleveland Underground Rapid Transit Co. Mayor Johnson's new plan involved regaining possession of the original 3-cent lines on the west side and unifying these with the proposed Payne Avenue line and its extensions into one 3-cent system. However, the Chamber of Commerce demanded a referendum on the Schmidt franchise and the Mayor was forced to begin a vigorous campaign in its favor. A campaign against the franchise was conducted by merchants and

citizens under the name, "Committee of 100." At the referendum election held August 3, 1909, the Schmidt ordinance was defeated.

The defeat of the Schmidt ordinance was followed by a resumption of negotiations between the City Council and the Cleveland Railway Co. with the Baker ordinance as a basis. After further conferences, the City Council agreed, on September 29, 1909, to the proposition of The Cleveland Railway Co. to submit the questions of valuation of the physical property and of maximum fare to Judge Tayler on condition that all other disputed questions were to be settled prior to arbitration.

The settlement proceedings were begun late in October, 1909, and continued until the middle of December, 1909. In the midst of the arbitration, Mayor Johnson was defeated at the Cleveland mayoralty election on November 2, by H. C. Baehr, Republican. Mr. Baehr had pledged himself to a settlement of the street railway question on the basis of a 6 per cent return on the stock of The Cleveland Railway Co., all earnings over that to go to the reduction of fare and the improvement of service. City Solicitor Newton D. Baker, was re-elected, but a majority of the old city councilmen were defeated. On December 18, Judge Tayler, as arbitrator rendered his decision, which was at once embodied in an ordinance and passed by the City Council, together with a provision for a street railway commissioner, who was to represent the city and have access at all times to the books and records of the Company. The ordinance was signed by Vice-Mayor Lapp and accepted by The Cleveland Railway Co. on December 20, 1909. At a referendum election held February 17, 1910, it was approved by a majority of 8,110.

On February 19, 1910, the initial rate of fare of 3-cents with 1-cent for transfer without rebate went into effect within the city limits, the fare in the suburbs being determined by prior contracts with the old company. On March 1, 1910, Receiver Warren Bicknell turned the property over to The Cleveland Railway Company and G. M. Dahl, newly appointed street railway commissioner, assumed the duties of his office.

The preceding historical summary concludes the story of Mayor Johnson's efforts to force The Cleveland Railway Company to render urban transportation service for a 3-cent fare. The adoption of the Tayler ordinance or "Working Agreement" marked the close of this preliminary stage. Subsequent chapters will deal with the success achieved by the Ordinance, both prior to and subsequent to the arbitration of 1913.

In Chapter XXIV, there will be discussed the developments which brought about the necessity of placing an official interpretation upon certain provisions of the Tayler ordinance and the financial situation which was disclosed at that arbitration. This chapter covers the operation of the Cleveland Railway for the three years ended February 28, 1913.

In Chapter XXIV, there will be discussed the efforts since the date of the arbitration to reduce costs of operation so that low fares might be continued. A rather unusual degree of cooperation exists between the parties at interest — the City Government, the riding public, and the Company — and this cooperation has had a considerable effect upon the costs of operation.

In Chapter XXV, the service rendered in Cleveland will be discussed from the standpoint of the problems of operation.

In Chapter XXVI, there have been brought together the financial results of operation for the two ordinance years ended February 28, 1915, together with a discussion of paying haul and the probable cost of making the service conform to standards in certain other cities.

The significant fact from the standpoint of the present study, seems to be that while many of the Cleveland citizens at the beginning of the movement for lower fares had but a slight conception of the existence and operation of certain fundamental laws of business under which capital can engage in public service enterprises, the six years of discussion had served to make the people somewhat more familiar with such elementary principles. The most important of these principles was that revenues cannot permanently be less than cost of service, including therein a fair return upon the necessary investment

## CHAPTER XXIII

### THE CLEVELAND EXPERIMENT (Continued)

### THE TAYLER ORDINANCE AND DEFECTS IN ITS OPERATION AS DISCLOSED AT ARBITRATION

The Provisions of the Tayler Ordinance,—— Difficulties During First Period of Operation,——Amendments of July 14, 1911,—— Changes in Rate of Fare,—— Events Preceding Arbitration,—— Defects of Plan Based on Allowances,—— Issues Presented at Arbitration,—— Difference Between Interest Fund and Corporate Surplus,—— Deficiencies in Allowance for Maintenance, Depreciation and Renewals,—— Deficiencies in Allowance for Operation,—— Findings of Arbitrators on Allowances,—— Status of Sundry Reserves Under the Ordinance,—— Legal Right of Company to Overexpend Allowances,—— General Conclusions Drawn from Facts Presented at Arbitration.

The rate of fare under Ordinance 16238-A, known as the Tayler Ordinance, granting a renewal of the street railway franchises of The Cleveland Railway Co., was fixed experimentally as 3-cents cash fare and 1-cent for transfer with no rebate. The ordinance by its terms, however, provided for a fluctuating rate of fare dependent upon the cost of service.

Its general intent is indicated in the preamble thus:

> It is agreed that a complete re-adjustment of the street-railroad situation should be made, upon terms that will secure to the owners of the property invested in street railroads security as to their property, and a fair and fixed rate of return thereon, at the same time securing to the public the largest powers of regulation in the interest of public service, and the best street-railroad transportation at cost, consistent with the security of the property, and the certainty of a fixed return thereon, and no more.

Briefly, this object was to be brought about as follows: [1]

1. The Cleveland Railway Co. was to operate the property.
2. The City of Cleveland, through its Council and the Council's technical adviser, the City Street Railroad Commissioner, was to prescribe the service.[2]

---

[1] The features of the plan as here stated, include subsequent amendments. The first ordinance was approved by a referendum vote on February 17, 1910, and the second amending the first, on November 7, 1911.

[2] Sec. 10 * * * The city street railroad commissioner shall act as the technical adviser of the council of the city of Cleveland in all matters affecting the interpretation, meaning or application of any of the provisions of this ordinance, and of action thereunder affecting the quantity or quality of service, or the cost thereof, or the rate of fare. He shall keep always informed as to all matters affecting the cost or quality or quantity of service furnished, the receipts and disbursements and property of the company, the rate of fare, the vouchering of expenditures; and if he disapproves of the vouchering of expenditures, or of the manner of keeping accounts or other matters affecting the bookkeeping of the company, he shall at once take the matter up with the company; and in case of disagreement the matter shall at once be submitted to the committee on standard classification of accounts of the American Street and Interurban Railway Accountants' Association, or to such person or persons upon whom the regulation of such matters may from time to time be devolved by law; and the decision of such committee, or person or persons, not inconsistent with the provisions of this ordinance, to whom this question is thus submitted, shall be final. * * *

3. The revenues of the Company were to be credited to a fund to be known as the "Interest Fund" established at $500 000. by an initial payment of that amount by the Railway Company.

4. To cover costs of operation the Railway Company was to be allowed:

(*a*) For Maintenance, Depreciation and Renewals, 4 cents per car mile during January, February, March, April, May and December; 5 cents per car mile during November; and 6 cents per car mile during June, July, August, September and October.

(*b*) For Operation 11.5 cents per car mile. This was increased to 12.1 cents per car mile as recommended by Board of Arbitrators, effective March 1, 1913, and further increased to 12.6 cents per car mile effective May 1, 1915.

These "allowances" were to be computed on the basis of total car mileage less all yard and house mileages, all mileage made by service equipment, and 40 per cent of the trailer car mileage. These amounts, technically termed "allowances", were to be deducted month by month from the interest fund.

5. Payments for Taxes, Interest and Dividends were to be estimated for the ordinance year, March 1, to February 28, and the following percentages of the estimated total taken from the interest fund each month.[1]

| | | | |
|---|---|---|---|
| March | 7% | September | 9% |
| April | 8% | October | 9% |
| May | 9% | November | 8% |
| June | 9% | December | 8% |
| July | 10% | January | 7% |
| August | 10% | February | 6% |

6. Interest at 6 per cent was to be calculated on the agreed valuation at the date of the taking effect of the ordinance, plus the value of such additions and the betterments as should be agreed upon by the city and the railway company, less, the bonded indebtedness of the company. On the funded debt, interest was to be allowed as disbursed. The rate is and has been 5 per cent per annum. The city has an indirect control of the issuance of securities through the exercise of its right to refuse the approval of extensions, betterments and permanent improvement. A further provision of the ordinance makes it necessary for the company to secure permission before selling any securities below par.

7. If at any time after a trial period of eight months the interest fund should amount to more than $700 000, the company was forthwith to put into effect the next lower rate of fare, and if the fund should

[1] In practice, the company deducts from income each month one-twelfth of the estimated annual taxes, bond interest and stock interest, instead of the percentages here shown, which are used only when it becomes necessary or desirable at any time to determine the amount in the interest fund on the basis of the deductions prescribed in the ordinance.

fall below $300 000, the next higher rate of fare.[1] The initial rate of fare was that step shown as (*e*) in the sliding scale of fares.[2]

8. It was agreed that the property as a whole should not be allowed to decrease in value to less than 70 per cent of cost new, which was estimated as the present value of the property when the present plan of operation went into effect.

---

[1] Sec. 23. * * * Whenever the amount credited to the interest fund, less the proportionate accrued payments to be made therefrom, shall be less than five hundred thousand dollars by the amount of two hundred thousand dollars, this shall be prima facie evidence of the necessity of raising the rate of fare to the next higher rate on the scale provided in Sec. 22 hereof.

Whenever the balance in the interest fund, less proportionate accrued payments to be made therefrom, shall be more than five hundred thousand dollars by the amount of two hundred thousand dollars, it shall be prima facie evidence of the necessity of lowering the rate of fare to the next lower rate on the scale provided in Sec. 22 hereof.

[2] The provision relating to the sliding scale of fares is as follows:

Sec. 22. The maximum rate of fare for a single continuous ride within the present limits of the city of Cleveland, in one direction, over any route of said company, shall be four (4) cents cash fare, seven (7) tickets for twenty-five (25) cents, one (1) cent transfer, no rebate; and, including said maximum rate, the following schedule or scale of fares is hereby established:

(*a*) Four (4) cents cash fare, seven (7) tickets for twenty-five (25) cents, one (1) cent transfer, no rebate.

(*b*) Four (4) cents cash fare, seven (7) tickets for twenty-five (25) cents, one (1) cent transfer, one (1) cent rebate.

(*c*) Four (4) cents cash fare, three (3) tickets for ten (10) cents, one (1) cent transfer, no rebate.

(*d*) Four (4) cents cash fare, three (3) tickets for ten (10) cents, one (1) cent transfer, one (1) cent rebate.

(*e*) Three (3) cents cash fare, one (1) cent transfer, no rebate.

(*f*) Three (3) cents cash fare, one (1) cent transfer, one (1) cent rebate.

(*g*) Three (3) cents cash fare, two (2) tickets for five (5) cents, one (1) cent transfer no rebate.

(*h*) Three (3) cents cash fare, two (2) tickets for five (5) cents, one (1) cent transfer, one (1) cent rebate.

(*i*) Two (2) cents cash fare, one (1) cent transfer, no rebate.

(*j*) Two (2) cents cash fare, one (1) cent transfer, one (1) cent rebate.

Each of the foregoing rates of fare, when in force shall be the rate of fare for a single continuous ride within the present limits of the city of Cleveland in one direction, over any route of said company, whether enumerated in Sec. 2 hereof or not; and when any of the foregoing rates of fare are in force with regard to which a ticket rate is provided, the company shall sell, on all of its cars, at all times, re-issuable tickets at the rate provided, each of which tickets shall entitle the holder to one such ride. At all times, any passenger demanding a transfer-ticket at the time of paying such cash or ticket rate of fare as shall then be in force, shall be entitled, under the provisions of the rate of fare then in force as to transfers, to transfer from the route on which he shall have paid such fare to any other route of said company, except in a substantially opposite direction on a route parallel or substantially parallel thereto, and to ride continuously to any point upon such second route within the limits of the city of Cleveland, provided he transfer to a car upon such second route within five minutes after leaving the car upon which he shall have paid fare, or to the first car of such company passing such transfer point upon such second route, and at the first point of intersection of said routes reached by the car upon which he shall have paid fare. If cars upon two or more routes are operated regularly along the same street, passengers who are able to reach their destination by one of said routes, without transfer to another of said routes, shall board a car upon the route reaching such destination, and shall not be entitled to transfer thereto from any other route.

Any passenger transferring to a car upon the East 55th street crosstown line of said company, or upon its crosstown line in East 105th street, Woodhill Road and East 93d street, or upon its crosstown line in West 65th street, shall, upon demand, at the time of presenting, within the time herein provided, a transfer-ticket to such crosstown line from any intersecting line of said Company, be entitled, without additional charge to transfer to any other route of said company intersecting such crosstown line, and to ride to any point upon such intersecting route, provided he transfer to a car upon such last-mentioned route within five minutes after leaving such crosstown car, or to the first regular car upon such last mentioned route.

The company shall not be required, however, to furnish a round-trip for a single fare, nor to carry any passenger to any point upon its railway and from such point to the vicinity of his starting-point for a single fare; and the company may, subject to the approval of the City Council, as hereinbefore provided, make such reasonable regulations, not inconsistent with the provisions of this ordinance, as may be necessary to prevent misuse of transfers.

Any child under six years of age, accompanied by a person paying fare, shall be carried ee. Two persons under six years of age, when accompanied by a passenger paying are, shall be carried for a single fare.

9. The "value" of the property as determined was agreed to be considerably less than the value of capital stock then outstanding.[1]

[1] The depreciation sustained in capital value may be determined from the following figures taken from Sec. 16 of Ordinance No. 16238-A, passed by the City of Cleveland, December 18, 1909, and from various published annual reports of the Company and of the Street Railroad Commissioner.

| | | |
|---|---|---|
| **Cleveland Electric Railway Company:** | | |
| Physical property as of January 1, 1908, (cost to reproduce less 30% depreciation) — (Note) | | $17,511,856 11 |
| Franchises | | 3,615,843 89 |
| Total | | $21,127,700 00 |
| **Forest City Street Railway Company:** | | |
| Physical property as of March 25, 1908, (cost to reproduce less 30% depreciation) — (Note) | | $1,805,600 00 |
| Value of property of the two companies | | $22,933,300 00 |
| Unpaid interest accrued during operation by Municipal Traction Company | | 1,158,300 00 |
| Total capital value as of January 1, 1910 | | $24,091,600 00 |
| Capital value represented by debt: | | |
| Bonded Debt | $8,128,000 | |
| Floating Debt | 1,288,000 | 9,416,000 00 |
| Total capital value represented by stock | | $14,675,600 00 |
| Stock outstanding January 1, 1910 | | 25,205,600 00 |
| Stock surrendered January 1, to February 28, 1910, or depreciation in security value | | 10,530,000 00 |
| Total stock outstanding March 1, 1910 | | $14,675,600 00 |

(Note): (Estimated depreciated value on that date. The value is divided into several schedules. The percentages of the depreciation varied; they were not alike for any two schedules, but the average for the whole property was about 30 per cent so that the value, January 1, 1908, was about 70 per cent of the cost of reproduction new. This is confirmed by Sec. 21 of the franchise, requiring that the property be kept in "good condition, thorough repair, and working order," the standard of such condition, repair and working order being an average for the entire system of 70 per cent of its reproduction value.)

| | |
|---|---|
| According to this valuation, the physical property at the time the present operating agreement was entered into was in 70 per cent condition and was inventoried, under operation of the ordinance, at | $19,317,456 11 |
| New, it would have cost to produce | 27,596,365 87 |
| The franchises were valued at | 3,615,843 89 |
| Accrued interest amounted to | 1,158,300 00 |
| Total | $32,370,509 76 |
| Of this there was represented by indebtedness (funded and floating) | 9,416,000 00 |
| The balance was represented by stock and amounted to | $22,954,509 76 |
| Representing this value there was outstanding prior to the adoption of the ordinance, stock to the amount of | 25,205,600 00 |
| A difference unaccounted for of | $2,251,090 24 |
| Stock surrendered amounted to | 10,530,000 00 |
| Leaving stock surrendered to cover estimated depreciation in property to 70% condition | 8,278.909 76 |
| Between March 1, 1910, and December 31, 1914, the funded and floating indebtedness of the Company was reduced by | 3,798,045 35 |
| And the capital stock increased by | 10,545,600 00 |
| Representing additions to property March 1, 1910, to December 31, 1914, of | $6,747,554 65 |

The conclusion to be reached is that the outstanding securities of the Cleveland Railway Company represented December 31, 1914, $10,530,000 less than the securities issued and $8,278,909.77 less than the cost to reproduce the various parts of the property at dates ranging from January 1, 1908, to September 28, 1914.

The following table indicates the situation as of December 31, 1914:

TABLE CXXV — CAPITALIZATION AND RETURN CLEVELAND RAILWAY Co., 1914

| ITEM | Amount | INTEREST PAID | | INTEREST EARNED (*d*) | |
|---|---|---|---|---|---|
| | | Amount | Per cent. | Amount | Per cent. |
| Stock outstanding | *a* $25,221,200 | $1,396,671 26 | 5.5 | $1,083,417 11 | 4.3 |
| Stock surrendered | 10,530,000 | ............ | 0.0 | ............ | 0.0 |
| Total Stock | 35,751,200 | 1,396,671 26 | 3.9 | 1,083,417 11 | 3.0 |
| Bonds | 5,495,000 | *b* 279,435 96 | 5.1 | *b* 279,435 96 | 5.1 |
| Total | 41,246,200 | *c* 1,676,107 22 | 4.1 | 1,362,853 07 | 3.3 |
| Total excluding Stock surrendered | $30,716 200 | $1,676,107 22 | 5.5 | $1,362,853.07 | 4.4 |

(*a*) Some of this stock issued during 1914.
(*b*) Includes $5,000.01 amortization bond discount.
(*c*) Does not include $26,152.46 interest on floating debt.
(*d*) Before depreciation charges.

It will be noted that the interest paid exceeds the interest earned by $313,254.15, the amount of the deficit shown on page 25 of the annual report of The Cleveland Railway Company for the year ended December 31, 1914.

10. Certain means were provided in the ordinance as amended July 14, 1911, for continuing and terminating the agreement.[1] Briefly, it was provided that not less than 15 years before the expiration of the franchise or ordinance, the City might —

(*a*) Purchase, by assuming outstanding liabilities and paying $110 per share for the capital stock, or designate a licensee agreeing to purchase on these terms, and to operate on the same basis as the present owners except in so far as interest which is to be paid at a rate of not more than 5.75 per cent.

(*b*) Extend the life of the ordinance.

In case the city failed to exercise its rights in either of these ways, more than 15 years before the expiration of the ordinance, the company should be free to charge the maximum rate of fare, 4 cents, plus 1 cent for transfer, no rebate, for the remainder of the life of the ordinance unless in the meantime the city extended the life of the ordinance and franchise for an additional period.

The first year's operation under the ordinance plan was one of conference and experiment and while a number of perplexing questions arose, there was generally evident an earnest effort toward effective coöperation between the city and the company. The rate of fare to

[1] Stripped of technicalities, the situation is that The Cleveland Railway Company has a franchise permitting it to operate until 1934, and an agreement prescribing rates of fare and the scheme of regulation expiring 15 years prior to the expiration of the franchise. Any extension of the franchise automatically extends the life of the operating agreement.

be charged to Collinwood, a suburb, was one source of trouble. The franchise fare was 10 cents but in May, 1910, the City Council adopted a resolution requesting the company to charge only 5 cents. Arbitration of labor difficulties resulted in a substantial increase in wages. Extensions were demanded which could not be financed and the actual operating expenses incurred exceeded the allowances under the ordinance.[1] The Council was not inclined to offer any practical relief for these conditions.

The trial period of eight months provided by the ordinance for the operation of a 3-cent fare plus 1-cent for a transfer was completed on November 30, 1910. As the interest fund was approximately $550 000 or about $50 000 more than the amount originally set up in the interest fund, the previous rate of fare was continued.

In March, 1911, the Cleveland Chamber of Commerce appointed a representative committee to inquire into the difficulties encountered under the operation of the ordinance and to suggest necessary changes. In May, 1911, the committee submitted a report. It found no necessity for an increase in the maximum rate of fare but made several other suggestions. On May 1, 1912, the City Council adopted a resolution increasing the operating allowance 1-cent per car mile for the period beginning May 1, 1912 and ending December 31, 1912.

On May 23, 1911, G. M. Dahl, Street Railway Commissioner, sent a communication to The Cleveland Railway Co., in which he stated that the amount in the interest fund exceeded the required $500 000 by $200 000, and that under the conditions of the Ordinance, the fare must be reduced to the next lower point in the sliding scale, which was straight 3 cents, with 1-cent for transfer to be rebated when transfers were presented. On May 29, 1911, the City Council adopted a resolution sustaining Mr. Dahl and accordingly on June 1, 1911, the 1-cent transfer charge was discontinued and a straight 3-cent fare was put into effect within the city limits. This rate of fare continued in effect until September 1, 1914.

In July, 1911, the City Council adopted and the company accepted amendments to the original Tayler Ordinance which had been under discussion for some time. The amendments were in part as follows:

1. The city to have the right to propose betterments and extensions.
2. The company to expend $2 500 000 at once for extensions and betterments designated by the City.
3. Low fare not to be extended to suburbs except Collinwood, which was to be made part of the City of Cleveland.

At the election on November 7, 1911, these amendments were approved by the voters and thereupon went into effect. Newton D. Baker, for some years City Solicitor of Cleveland, was elected Mayor

---

[1] For a comprehensive description of the accounting provisions of the ordinance and the financial and operating results for the first six months' period as compared with corresponding periods of 1906, 1907, 1908 and 1909, see H. J. Davies — Some Accounting Features of The Cleveland Railway Company's Franchise. 1910 *Proceedings American Street and Interburban Railway Accountants' Association*, page 125.

in 1911. Mayor Baker appointed Peter Witt, former City Clerk, Street Railway Commissioner.

During all this period, there was a gradual accumulation of deficits in the operating and maintenance funds. At a conference of city and railway officials, on February 5, 1913, President Stanley, for the Railway Company, advocated an increase in fare, the city officials demanded the transfer of the injuries and damage fund and the insurance fund accumulations to the interest fund, thus obviating the necessity for any increase in fare. Subsequent requests on April 19, 1913, to the City Council for permission to increase the Ordinance allowances for Maintenance and Operation were refused, and a decrease in fare ordered, beginning with May 1, 1913, being 3-cents cash, 2-tickets for 5-cents and 1-cent charge for transfer. The company thereupon demanded arbitration in accordance with the terms of the Ordinance, naming C. N. Duffy (Milwaukee) as its representative. A. B. duPont was chosen by the City and the selection of a third arbitrator was left to Justice Day of the Federal Court. Justice Day appointed Justice J. M. Killits, (Toledo, Ohio) the third abitrator.

Before examining the questions proposed by the City and the company for solution by the Arbitration Board, it will be well to note that while the Tayler Ordinance as set forth in its preamble has the joint purpose of making fares conform to cost and of preserving the integrity of the capital investment, the justice and ultimate success of the plan must depend upon the sufficiency of the Ordinance allowances. When it is considered that no fund was allowed to be accumulated for retiring worn out equipment, but that it was contemplated that renewals in addition to the usual maintenance and repair of way, structures and equipment could be made from an allowance of about 5 cents per car mile, it is obvious that adjustment in this item would sooner or later become necessary. It is equally plain that the so-called operating allowance of 11.5 cents per car mile was bound to prove inadequate.

The reference to the Board of Arbitration covered a large number of controverted points. The issues finally decided of chief interest to the present study, were as follows:

1. There is an over expenditure of Maintenance, Depreciation and Renewal allowance —
   (*a*) How shall this be taken care of?
   (*b*) What measures can be taken to prevent the recurrence of such an over-expenditure?
2. There is an over-expenditure of the Operation allowance —
   (*a*) How shall this be taken care of?
   (*b*) What measures can be taken to prevent the recurrence of such an over-expenditure?
3. There is an accumulation in the Injuries and Damages Reserve. Is such an accumulation contemplated by the ordinance?
4. There is an accumulation in the Insurance Reserve. Is such an accumulation contemplated by the ordinance?

TABLE CXXVI — INCOME ACCOUNT — THE CLEVELAND RAILWAY COMPANY — BASED ON RECEIPTS AND EXPENDITURES FOR FIRST THREE YEARS UNDER OPERATION OF ORDINANCE

| Item | Ten months ended December 31, 1910 | Year ended December 31, 1911 | Year ended December 31, 1912 | Two months ended February 28, 1913 | Total, thirty-six months |
|---|---|---|---|---|---|
| **Operating revenue, total** | **$5,187,206 91** | **$6,367,449 12** | **$6,648,755 71** | **$1,080,666 66** | **$19,284,078 40** |
| Total passenger revenue | 5,033,299 90 | 6,181,891 36 | 6,460,381 83 | 1,052,464 27 | 18,728,037 36 |
| Passenger fares | 4,609,956 26 | 5,954,041 02 | 6,437,026 20 | 1,049,204 02 | 18,050,227 50 |
| Employes fares | 24,731 82 | 27,370 33 | 23,355 63 | 3,260 25 | 78,718 03 |
| Transfers | 398,611 82 | *a*200,480 01 | 801,690 27 | 131,504 98 | 1,532,287 08 |
| Other transportation revenue | .......... | 128,633 99 | 130,062 00 | 18,942 60 | .......... |
| Other operating revenue | .......... | 56,923 77 | 52,311 88 | 9,259 79 | .......... |
| **Operating expenses, total** | **3,963,446 12** | **4,915,160 61** | **4,935,574 14** | **793,641 07** | **14,607,821 94** |
| Total maintenance | 1,361,337 34 | 1,515,212 02 | 1,387,427 47 | 215,078 83 | 4,479,055 66 |
| Maintenance of way and structures | .......... | .......... | 755,002 95 | 66,266 79 | .......... |
| Maintenance of equipment | .......... | .......... | 632,424 52 | 148,812 04 | .......... |
| Maintenance of power plants | .......... | .......... | .......... | .......... | .......... |
| Total operation | .......... | .......... | 3,548,146 67 | 578,562 24 | .......... |
| Traffic | .......... | .......... | 1,159 19 | .......... | .......... |
| Operation of power plant | .......... | .......... | 509,881 81 | 98,390 68 | .......... |
| Conducting transportation | .......... | .......... | 2,431,279 20 | 385,300 71 | .......... |
| General and miscellaneous, accidents | .......... | .......... | 232,873 59 | 34,984 37 | .......... |
| General and miscellaneous, insurance | .......... | .......... | 54,000 00 | 4,870 66 | .......... |
| General and miscellaneous, city commissioner | .......... | .......... | 44,017 00 | 7,745 43 | .......... |
| General and miscellaneous, other | .......... | .......... | 274,935 88 | 47,270 39 | .......... |
| **Net operating revenue** | **1,223,760 79** | **1,452,288 51** | **1,713,181 57** | **287,025 59** | **4,676,256 46** |
| **Non operating revenue, total** | **31,946 90** | **55,760 06** | **31,016 80** | **11,192 65** | **129,916 41** |
| Rentals | 4,425 03 | 1,988 94 | *D 381 57* | 952 67 | 6,985 07 |
| Interest | 27,521 87 | 53,771 12 | 31,398 37 | 10,239 98 | 122,931 34 |
| Miscellaneous | .......... | .......... | .......... | .......... | .......... |
| **Gross income** | **1,255,707 69** | **1,508,048 57** | **1,744,198 37** | **298,218 24** | **4,806,172 87** |
| **Fixed charges, total** | **689,398 49** | **907,988 81** | **878,094 54** | **145,059 89** | **2,620,541 73** |
| Rentals | .......... | .......... | .......... | .......... | .......... |
| Taxes | 310,598 08 | 370,454 68 | 366,591 04 | 62,095 47 | 1,109,739 27 |
| Interest, funded debt | 339,625 00 | 514,085 56 | 499,999 98 | 81,956 09 | 1,435,666 63 |
| Interest, floating debt | 39,175 41 | 23,448 57 | 6,503 51 | 175 00 | 69,302 49 |
| Other | .......... | .......... | 5,000 01 | 833 33 | 5,833 34 |

| | | | | | |
|---|---|---|---|---|---|
| **Net corporate income** | **566,309 20** | **600,059 76** | **866,103 83** | **153,158 35** | **2,185,631 14** |
| **Disposition** | ........ | ........ | ........ | ........ | ........ |
| Interest on stock | 749,222 50 | 903,635 65 | 905,039 10 | 181,699 45 | 2,739,596 70 |
| Surplus | ........ | ........ | ........ | ........ | ........ |
| Deficit | 182,913 33 | 303,575 89 | 38,935 27 | 28,541 10 | 553,965 59 |
| **Surplus fund** *b* | **317,086 67** | **13,510 78** | *D* 25,424 49 | *D* 53,965 59 | *D* 53,965 59 |

*a* Includes employees transfers.
*b* It is assumed that the surplus fund was $500,000 on March 1, 1910, for comparison with interest fund.
*D* = Deficit

TABLE CXXVII — INCOME ACCOUNT — THE CLEVELAND RAILWAY COMPANY — BASED ON RECEIPTS AND ALLOWANCES FOR FIRST THREE YEARS UNDER OPERATION OF ORDINANCE

| FINANCIAL DATA | Ten months ended December 31, 1910 | Year ended December 31, 1911 | Year ended December 31, 1912 | Two months ended February 28, 1913 | Total, thirty-six months |
|---|---|---|---|---|---|
| **Interest fund, first day** | $500,000 00 | $575,994 11 | $373,864 53 | $484,282 98 | $500,000 00 |
| Credits, total | 5,219,153 81 | 6,423,209 18 | 6,679,772 51 | 1,091,859 31 | 19,413,994 81 |
| Operating revenue | 5,187,206 91 | 6,367,449 12 | 6,648,755 71 | 1,080,666 66 | 19,284,078 40 |
| Other income | 31,946 90 | 55,760 06 | 31,016 80 | 11,192 65 | 129,916 41 |
| Debits, total | 5,143,159 70 | 6,625,338 76 | 6,569,354 06 | 1,038,972 88 | 19,376,825 40 |
| Allowances, total | 3,704,126 50 | 4,813,714 30 | 4,786,220 42 | 712,213 54 | 14,016,274 76 |
| Maintenance, Ren. & Dep. regular | 1,142,919 39 | 1,390,079 90 | 1,438,662 29 | 183,797 04 | 4,155,458 62 |
| Maintenance, Ren. & Dep., special | ........ | ........ | ........ | ........ | ........ |
| Operation, regular | 2,561,207 11 | 3,423,634 40 | 3,347,558 13 | 528,416 50 | 9,860,816 14 |
| Operation, special | ........ | ........ | ........ | ........ | ........ |
| Other | ........ | ........ | ........ | ........ | ........ |
| Taxes | 311,010 29 | 370,454 68 | 366,591 04 | 62,095 47 | 1,110,151 48 |
| Interest | 1,128,022 91 | 1,441,169 78 | 1,416,542 60 | 264,663 87 | 4,250,399 16 |
| Miscellaneous | ........ | ........ | ........ | ........ | ........ |
| **Increase in interest fund** | 75,994 11 | ........ | 110,418 45 | 52,886 43 | 239,298 99 |
| **Decrease in interest fund** | ........ | 202,129 58 | ........ | ........ | 202,129 58 |
| **Interest fund, last day** | 575,994 11 | 373,864 53 | 484,282 98 | 537,169 41 | 537,169 41 |

TABLE CXXVII — (*Concluded*)

| Operating Statistics | Ten months ended December 31, 1910 | Year ended December 31, 1911 | Year ended December 31, 1912 | Two months ended February 28, 1913 | Total, thirty-six months |
|---|---|---|---|---|---|
| *Passengers* | | | | | |
| Number of fares | 149,912,949 | 189,244,894 | 203,349,655 | 33,407 862 | 575.915 360 |
| Number of employes passes | 824.394 | 848,729 | 777,137 | 108,675 | 2,558,935 |
| Number of dead heads | 1,233,279 | 3,025,429 | 2,793,693 | 412,982 | 7,465,383 |
| Number of transfers | 48,682 856 | 68,918,387 | 80,169,027 | 13,150,498 | 210,920,768 |
| **Total number of rides** | **198,186,920** | **262,037,439** | **287,089,512** | **47,080,017** | **794,393,888** |
| *Car miles (revenue)* | | | | | |
| Motor, city | 20,414,472 | 26,498,965 | 27,322,762 | 4,256,096 | 78,492,295 |
| Motor, interurban | 1,014,602 | 1,241,516 | 1,264,734 | 193,949 | 3,714,801 |
| Trailer, 60 per cent | 644,123 | 110,631 | 276,800 | 111,937 | 1,143,491 |
| Trailer, 100 per cent | 1,073,538 | 184,385 | 461,333 | 186,562 | 1,905,818 |
| Mail, express, etc | 198,169 | 235,742 | 244,905 | 32,944 | 711,760 |
| **Total ordinance** | **22,271,366** | **28,086,854** | **29,109,201** | **4,594,926** | **84,062,347** |
| **Total actual car miles** | **22,700,781** | **28,160,608** | **29,293,734** | **4,669,551** | **84,824,674** |

5. A considerable amount of physical property has been so worn as to make its further use impossible. How shall this fact be treated in the light of the ordinance provision for the unimpairment of the Company's plant?

The essential facts before the arbitrators may be summarized from the financial statements of the company. The provisions of the ordinance relating to cost have necessitated the keeping of two income accounts, one following the usual accounting practice and based upon actual expenditures, the other based on "allowances" provided in the ordinance. Throughout this discussion the terms "actual" and "ordinance" will be used in referring to these sets of accounts. Table CXXVI discloses the record of receipts and expenditures of the Railway Company for the first three years of its operation under the ordinance, while Table CXXVII covers the same period under the system of accounts as necessitated by the ordinance. From a comparison of these tables it is evident that the fluctuations of the interest fund were not a true gauge of the Railway's financial condition. Table CXXVIII compares the status of the surplus fund and the interest fund, assuming each to have been $500 000 on March 1, 1910.

Table CXXVIII.— Comparison of Interest Fund and True Corporate Surplus.

| As of | Interest Fund | Corporate Surplus (a) | Surplus less than Interest Fund by |
|---|---|---|---|
| March 1, 1910 | $500,000.00 | $500,000.00 | ............ |
| December 31, 1910 | 575,994.11 | 317,086.67 | $258,907.44 |
| December 31, 1911 | 373,864.53 | 13,510.78 | 360,353.75 |
| December 31, 1912 | 484,282.98 | (*D*) *25,424.49* | 509,707.47 |
| February 28, 1913 | 537,169.41 | (*D*) *53,965.59* | 591,135.00 |

(a) Assumed to be $500,000 March 1, 1910 for purposes of comparison.

It was the duty of the arbitrators to determine what should be done to correct this evident departure of actual cost from "allowance" cost, and, treating in order the five issues stated above, the findings of fact and the recommendations were as follows:

Table CXXIX.— Maintenance, Renewal and Depreciation

| Period | Allowance | Expenditure | Overdraft |
|---|---|---|---|
| March 1, 1910 to December 31, 1910 | $1,142,919.39 | $1,361,337.34 | $218,417.95 |
| January 1, 1911 to December 31, 1911 | 1,390,079.90 | 1,515,212.02 | 125,132.12 |
| January 1, 1912 to December 31, 1912 | 1,438,662.29 | 1,387,427.47 | (*s*) 51,234.82 |
| January 1, 1913 to February 28, 1913 | 183,797.04 | 215,078.83 | 31,281.79 |
| March 1, 1910 to February 28, 1913 | $4,155,458.62 | $4,479,055.66 | $323,597.04 |

(*s*) Surplus.

(1) The allowances for maintenance, depreciation and renewals were inadequate. Table CXXIX shows the allowances and expenditures for maintenance, renewals and depreciation during the three years from March 1, 1910, to February 28, 1913, as disclosed by the Company's books.

The overdraft of $323,597.04, the arbitrators decreed should be liquidated in such amounts from time to time as could be transferred from the interest fund without reducing the interest fund below $400,000. Under this ruling the overdraft has been reduced from time to time as follows:

| | | |
|---|---|---|
| Amount of Overdraft — March 1, 1913 ............ | | $323,597.04 [1] |
| Credit by transfer from interest fund, August 31, 1913 .......................... | $106,152.44 | |
| Credit by transfer from earnings, $6,000 per month, March, 1914 to February, 1915 ................................ | 72,000.00 | |
| | | 178,152.44 |
| Amount of Overdraft — March 1, 1915 ........ | | $145,444.60 |

The Board stated that it realized the vital relation of the maintenance, renewal and depreciation fund to those provisions of the ordinance which demanded that the securities and capital of the Company shall be maintained without impairment, but it was unable from the evidence on hand to determine satisfactorily whether the prevailing allowances should be increased. It was the opinion of the majority of the Board, therefore, Mr. Duffy dissenting, that the Company again start with the presumption that the average allowance would provide an adequate maintenance, renewal and depreciation fund, because officers of the Company, having long experience, accepted this appropriation in the framing of the measure.

(2) The allowances for operation were insufficient. Table CXXX indicates in a manner similar to Table CXXIX, the expenditures and allowances for operation during the first three ordinance years, as appearing from the Company's books:

TABLE CXXX.— OPERATION.

| Period | Allowance | Expenditure | Overdraft |
|---|---|---|---|
| March 1, 1910 to December 31, 1910... | $2,561,207.11 | $2,602,108.78 | $40,901.67 |
| January 1, 1911 to December 31, 1911.. | 3,423,634.40 | 3,385,686.61 | (s) 37,947.79 |
| January 1, 1912 to December 31, 1912.. | 3,347,558.13 | 3,548,146.67 | 200,588.54 |
| January 1, 1913 to February 28, 1913... | 528,416.50 | 584,466.61 | 56,050.11 |
| March 1, 1910 to February 28, 1913.... | $9,860,816.14 | $10,120,408.67 | $259,592.53 |

(s) Surplus.

[1] It should be borne in mind in considering this overdraft that the expenditures had contained nothing for the accumulation of a depreciation fund, and that this amount is less than the true deficiency of the allowance by whatever depreciation had accrued during the three years.

It will be noted that the allowance for operation had been over-expended on February 28, 1913, by $259,592.53. This amount on the recommendation of the arbitrators was taken care of by the transfer on July 31, 1913, of the whole amount from the interest fund.[1] The Board unanimously determined that there should be an increase of 0.6 of a cent per car mile, making an allowance of 12.1 per car mile, effective March 1, 1913. This increase seemed necessary, due to enhanced cost of labor and other considerations.

(3) and (4) Reserves for injuries and damages and for insurance were not contemplated by the ordinance. Table VI indicates the balances in these two reserve funds, as shown at various times during the first three ordinance years:

TABLE CXXXI.— RESERVE FUNDS

| | Insurance Reserve | Injuries and Damages Reserve | Total |
|---|---|---|---|
| Balance in Fund, December 31, 1910... | $5,403.11 | $61,455.71 | $66,858.82 |
| Balance in Fund, December 31, 1911... | 28,879.79 | 131,766.76 | 160,646.55 |
| Balance in Fund, December 31, 1912... | 58,919.21 | 151,181.00 | 210,100.21 |
| Balance in Fund, February 28, 1913.... | 63,048.55 | 152,954.33 | 216,002.88 |

The accumulated amount of $216,002.88 was credited to interest fund on July 1, 1913, under the finding of the arbitrators, that the practice of the Company of maintaining an accident fund, to which was credited currently 0.8 of 1 cent per car mile and to which were charged all expenditures under this account, could not be justified under the ordinance and that at the end of each ordinance year any unexpended balances in this fund must be credited to the Interest Fund.[2] A similar finding was made with regard to the Insurance Fund, so that since that date, March 1, 1913, the Company has not maintained any reserve for insurance or accidents, but has charged to these accounts from time to time such disbursements as were actually made.

(5) Integrity of physical property. At the time of the arbitration, there had been retired from service certain physical property which it was no longer possible to operate. The value of this property had been credited to the proper account and charged to the maintenance, renewal and depreciation reserve. Subsequently when an arrangement was made with the city to spread the value over a

[1] See page 9, Award of Arbitrators and Ordinance 30017 adopted by Cleveland City Council July 14, 1913.

[2] The opinion of the Board states: "While it is entirely plain that safe business policy demands such practices by a company acting under a franchise of the character in general operation — allowing all profits to go to stockholders — to the end that current business and capital may not be affected by the liquidation of damage claims originating in previous periods of operation, the majority sees in provisions peculiar to the ordinance before us, controlling reasons why such practice is here not only unnecessary but is practically forbidden." * * *

period of years, a suspense account was opened at the suggestion and request of the City Street Railroad Commissioner. The Board recommended that "it appears highly desirable that, as soon as possible a clean slate should be started, even through the application of some extraordinary measures." The amount finally agreed upon between the City Street Railroad Commissioner and The Cleveland Railway Co., as the value of the equipment retired was $705,347.67. During the year 1914, this was reduced by $32,344.70, through credit for salvage and during the twelve months ended February 28, 1915, there was written off $144,000, or at the rate of $12,000 per month. This leaves the amount in the road and equipment suspense account on March 1, 1915, as $529,002.97.

A considerable amount of discussion was given to the question of the legal right of the company to over-expend the allowances and it was finally determined that the ordinance contemplated that any material departure from the current rate of expenditure required the approval of the City Street Railroad Commissioner. It was evident, however, that this rule would have to be applied with some degree of reasonableness, inasmuch as it was manifestly impossible for the Company or the Street Railroad Commissioner to foresee accurately a large number of the changes which occur from time to time in the rate of expenditure of the Railway Company.

From a practical standpoint, the operating results, disclosed at the time of the arbitration, indicated that while the plan of regulation of The Cleveland Railway property had many admirable features, the plan was nevertheless economically unsound, inasmuch as it did not permit revenues sufficient to cover the costs of operation, to maintain the property and to permit such a return upon the investment as would enable the company to compete in an open market for additional funds.[1]

The conclusions of Mr. C. Nesbitt Duffy, a member of the Board of Arbitration are pertinent.

From the foregoing, it would appear that the Cleveland franchise plan did not meet the Cleveland situation, nor would it meet the situation in any other city for the following reasons:

(1) Because the service is inadequate and unsatisfactory, measured by the usual standards obtaining, far from being "the best street railroad transportation," as prescribed by the ordinance, not only with respect to the number of cars, but also with respect to the liimted trackage operated, from the standpoint of population and territory served.

(2) Because the cost of the service, inadequate and unsatisfactory as it is, is greater than the receipts from the rates of fare prescribed by the ordinance, if proper allowance and provision was made for Insurance Reserve, Accident Reserve, and Maintenance, Depreciation and Renewal Reserve, to say nothing of an Amortization Reserve.

---

[1] A comprehensive survey of the Cleveland Railway situation is contained in the address of Mr. C. Nesbitt Duffy, a member of the Board of Arbitration,. 1913 Proceedings, *American Electric Railway Association*, page 110.

(3) Because the capital value as determined by the ordinance does not represent what the investment in the Cleveland system was, or what the investment in any other similar street railway system would be, operating the same amount of trackage as The Cleveland Railway Co. operates, without regard to what the trackage should be, based on population and territory served.

(4) Because the rate of return — on bonds 5 per cent. on bills payable 6 per cent. on capital stock 6 per cent. with no adequate margin of safety, is not sufficient to properly compensate capital for the risks undertaken, incident to the hazards of the street railway business.

(5) Because there is no assurance that the capital value as determined by the ordinance, or experience in its interpretation after over three years of operation, will be unimpaired at the expiration of the franchise, there being no requirement that the city, or any other purchaser, be compelled to purchase the property of the company at the capital value determined by the ordinance, or provision for the amortization of the loss in said capital value, bound to be sustained at the expiration of the franchise.

(6) Because of the rather general recognition that street railway transportation in Cleveland is being furnished at less than cost and that any disturbance of present conditions would result in a book deficit.

(7) Because the machinery apparently provided in the ordinance for insuring against and financing depreciation is similar to the "assessment insurance" of fraternal societies, now pretty effectively discredited as a safe means of providing against the contingencies of sickness and death.

(8) Because the difficulties so far encountered in carrying out the intent of the ordinance, as set forth in Sec. 47 thereof, and the political hazard which any city administration would assume in attempting to recognize this intent in a practical way, will sooner or later be fully appreciated by the junior security holders and their capital will be withheld for investment in enterprises where the dividends and preservation of principal are more certain.

# CHAPTER XXIV

## THE CLEVELAND EXPERIMENT (Continued)

### EFFORTS SINCE ARBITRATION TO REDUCE COST OF OPERATION TO PERMIT CONTINUATION OF LOW FARES

Termination of Lines in Center of City,—— Designated Stops, —— Increased Schedule Speed,—— Decreased Accident Hazard, —— Policy with Respect to Extension of Lines,—— Paving Costs, —— Control of Traffic,—— Short-routing.

The partial recognition by the Board of Arbitration of actual costs of operation in lieu of "allowances" as set forth in the Ordinance, brought the Cleveland city officials, exercising a supervisory control over the service of The Cleveland Railway Co., face to face with the problem of continuing low fares by unusual economies in operation. There has resulted, largely during the administration of Commissioner Peter Witt, a degree of coöperation between the City Council, the public and the railway, which is unique in American cities, and goes far to explain the unusually low costs in the conduct of the traction business in Cleveland. It is not necessary to explain the various actions which have brought about these conditions of operation; in fact, many of the changes have been brought about gradually. The purpose of the study is best served by discussing under appropriate headings the facts disclosed upon an inspection by the Bureau of Fare Research in May, 1915.

#### Termination of all Lines in the Center of the City.

The principal avenues of travel in Cleveland radiate from the business center of the city, which is located on the Lake front. (Fig. 47.) There are eleven radial lines leading in a general easterly direction and five leading to the west. Under the present arrangement, each of these lines terminates in the center of the city. A large percentage of all the cars pass around one of the five loops which were installed under the direction of Mayor Johnson, who ordered that tracks be laid through and about the Public Square. A very large proportion of all the traffic in and out of town originates or terminates in this Square. This makes without doubt, for efficiency and economy in operation, but it is not difficult to imagine the public resentment which would result from the proposal on the part of many companies to lay tracks through and across a public square, in places four abreast. (Fig. 48.) One of the chief disadvantages of through lines from the standpoint of economical operation is the asymmetry of cities, which leads to unbalanced ends. These difficulties are entirely avoided in Cleveland.

The effect that this plan of stopping all cars in the center of town has on the revenues is probably not as great as the effect upon

operating cost, although it is now necessary in some cases for the rider to pay 7 cents to get across town. Under the present scheme of fares in Cleveland, the cash fare for the initial ride is 3 cents and the charge for a transfer is 1 cent. A free transfer will be issued on certain lines upon the transfer for which 1 cent was paid, so that it is possible to ride upon three lines for 4 cents. If, however, there is a point upon the west side of town, to which a patron

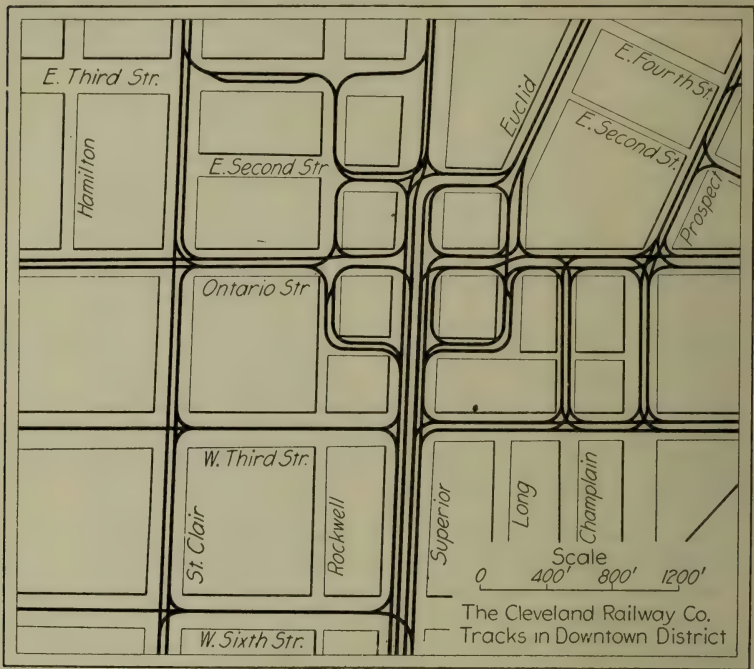



FIG. 48.

living on the east side wishes to go, it will frequently be necessary for him to pay an additional cash fare of 3 cents to reach his destination. The total amount of revenue from such fares, however, is probably not great and the inconvenience of transfer at the center of the city is the chief disadvantage with which the public is willing to contend in order to promote the economies of operation incident to the short routing of all cars in the center of the city.

## Designated Stops

One of the most important contributions to the economy of operation of The Cleveland Railway Co., which has been made by the traveling public, is the use of skip stops. This matter was first taken up by the Commissioner, Peter Witt, in a communication to the City Council, recommending the elimination of 45 per cent of the stops on the Superior Avenue line. The correspondence in this matter


FIG. 47.—LINES OF THE CLEVELAND RAILWAY CO.

follows, and is typical of that occurring subsequently with reference to other lines. All together about 47 per cent of the stops in the city of Cleveland were eliminated in this manner but there has been pressure brought by various interests affected, resulting in the restoring of certain of the eliminated stops until the percentage of designated stops at present has increased from 53 to 64.

LETTER FROM CITY STREET RAILROAD COMMISSIONER TO CITY COUNCIL SUBMITTING PROPOSED SUPERIOR AVENUE SCHEDULE

File No. 23476

Cleveland, January 8, 1912.

*To the Council of the City of Cleveland:*

GENTLEMEN:— In order to improve service and expedite travel on the street car lines of this City, your Street Railroad Commissioner, in compliance with a widespread demand, and by virtue of power reserved by the City in Sec. 9 of the Ordinance under which The Cleveland Railway Co. is now operating, has submitted to the car riders on Superior Avenue a measure which aims to eliminate unnecessary stops on that line.

The submission of this measure took the form of a referendum, in which each Superior Avenue car-rider was handed the attached self-explanatory ballot.[1]

"FOR THE CHANGE,
"Tear Off This End

..........................................................................

"Under the Tayler ordinance, the routing of cars, the making of schedules and the fixing of stops is under the control of the Street Railroad Commissioner.

"A faster schedule on this line should be made. It will take you to and from town quicker and will improve service. This can be done by cutting down unnecessary stops.

"On the other side is a diagram showing the proposed arrangement of stops. Cars bound for town will stop at alternate streets. Cars returning from town will stop at all other streets.

"This will mean a walk of only one block by each car-rider, either in the morning or evening. The inconvenience will be insignificant, the saving in time great.

"This change will mean better service, but it will not be made unless you want it. If you favor the change tear off the top of this card and hand it to the man. If not, tear off the bottom.

..........................................................................

"AGAINST THE CHANGE,
"Tear Off This End."

On Tuesday, January 2, and Wednesday, January 3, employes of your Commissioner's staff boarded cars on this line during the hours of maximum service, and handed duplicates of the aforementioned ballot to the passengers. An overwhelming number of the voters endorsed the change, those voting in favor representing 81.5 per cent of all the voters, and those opposed only 18.5 per cent. In other words, the proposal carried by a majority of more than four to one. So decisive was the approval given to the proposal and so truly did it reflect the sentiment of the car-riding public most vitally affected, that it was deemed unnecessary to continue the referendum indefinitely

[1] A similar ballot used later in connection with the Cedar Avenue line is reproduced in Fig. 49 and 50 in full size (obverse and reverse).

# For the CHANGE.

TEAR OFF THIS END.

---

Superior, Payne, St. Clair and Wade Park avenue car-riders have given an over-whelming endorsement to the proposal to cut down unnecessary stops, and as a result will get better service.

Car-riders on the CEDAR Ave. line can have better service also by approving a similar plan.

On the other side is a diagram showing the proposed arrangement of stops. Cars bound FOR town will stop at ALTERNATE streets. Cars running FROM town will stop at all other streets.

This will mean a walk of one block by each car-rider, either in the morning or evening. The inconvenience will be small, the saving in time great. You will be taken to and from town QUICKER and service will be greatly IMPROVED.

But the change will not be made unless YOU want it.

If you favor the change, tear off the top of this card, and hand it to the man. If not, tear off the bottom.

33

---

# Against the CHANGE.

TEAR OFF THIS END.

FIG. 49.— SKIP STOP BALLOT.

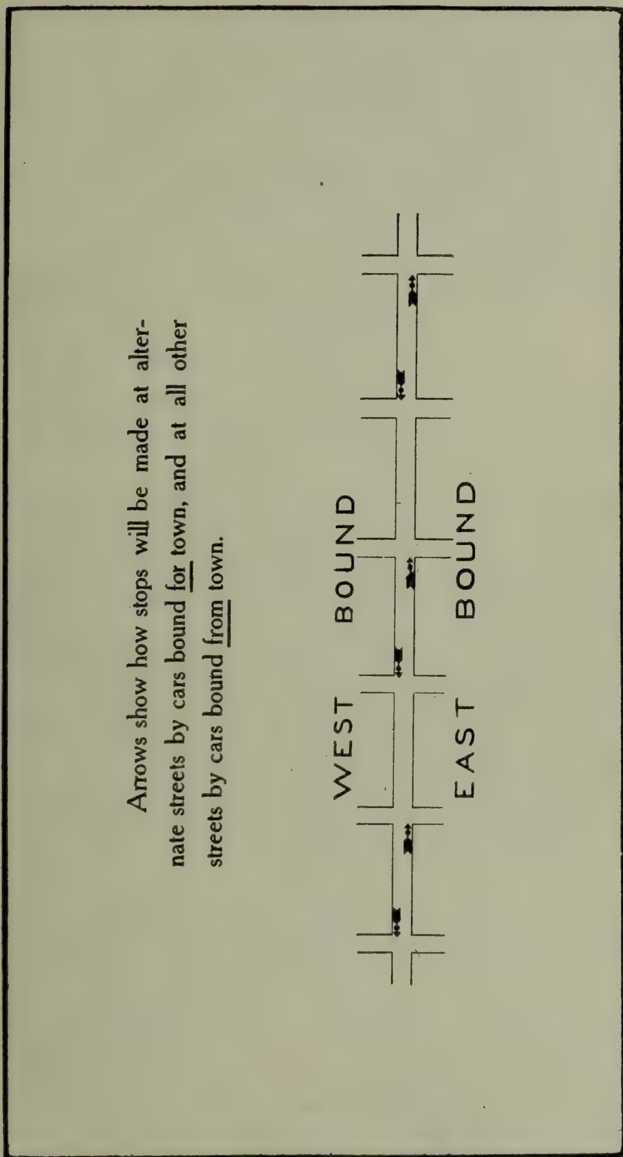



FIG. 50.— SKIP STOP BALLOT.

and unwise to thus employ a limited staff of men at the sacrifice of attention to other demands of the car-riding public equally as pressing.
The Commissioner has since been amply supported in that conclusion by a practical universal public approbation of the measure.
In the light of the foregoing facts, your Commissioner, therefore, recommends the following arrangement of stops on the Superior Avenue line, and respectfully asks for an early consideration of the same. It will be observed that the stops in the Western terminal district (Public Square to East 9th St.) and at the Eastern terminus of the line are not affected by the proposed change.

(Here follows list of proposed stops for Superior Avenue.)

| | |
|---|---|
| Total Proposed . . . | 84 |
| Total Present . . . | 154 |
| Total Saving . . . | 70-45% |

Very truly yours,
PETER WITT,
City Street Railroad Commissioner.

RESOLUTION ADOPTED BY CITY COUNCIL JANUARY 15, 1912, APPROVING SUPERIOR AVENUE SCHEDULE.

File 23535.

MR. HASERODT: *Whereas,* the schedule time on the Superior Avenue Street Railway line can be materially reduced and service improved by eliminating unnecessary stops; and

*Whereas,* the proposal to eliminate alternate stops on this line has been approved by the Superior Avenue car riding public in a referendum conducted by the staff of the Street Railroad Commissioner on January 2, 1912;

*Now, therefore, be it resolved,* by the Council of the City of Cleveland, state of Ohio, that the hereunto attached schedule of stops on the Superior Avenue Street Railway line be and is hereby approved;

*And, be it further resolved,* that the street railroad commissioner be and he is hereby directed to put the said schedule of stops into effect at the earliest and most practicable moment.

It is of considerable interest to note that the ballot was taken on cars rather than elsewhere, thus making use of the well-known feeling of passengers that the function of a car is motion. Few passengers look with favor upon stops other than the one at the street where they wish to alight and the result of the ballot taken was overwhelmingly in favor of the elimination of practically every other stop on the line. The average distance between stops before the designated stop system was adopted and since is indicated for the various lines by Table CXXXII. It is impossible to say definitely what the effect of this elimination of stops is on the distance walked by passengers, but applying roughly the percentage of passengers who are normally tributary to the eliminated stops, it appears that the additional distance walked due to the elimination of these stops is probably about one hundred fifty feet.

## INCREASED SCHEDULE SPEED

One very important effect of the elimination of stops is shown in the increased speed of cars. Table CXXXIII shows the schedule speed

in miles per hour both before and after the inauguration of the designated stop system. It will be observed that this increase in speed would mean, in platform wages alone, a saving of 13.2 per cent, or a saving based on the total pay roll of conductors and motormen of The Cleveland Railway Co. for the calendar year 1914, of $263 500. It is of interest that this amount is 30 per cent in excess of that laid down in the ordinance as measuring the success or failure of any particular rate, a decrease of $200 000 in the interest fund determining the need of a higher rate of fare. There are, however, other savings in cost not so easily calculated, but none the less real. A higher speed means the handling of more passengers per car throughout the year and also more car miles per mile of track.

### Decreased Accident Hazard.

The elimination of stops tends to decrease claims for injuries and damages arising out of boarding and alighting accidents. The passengers chiefly liable to boarding and alighting accidents are the first and last on and off at each stop. It is probable that the elimination of 50 per cent of the stops, while doubling the average number of passengers handled per stop, would lessen materially the number of boarding and alighting accidents. Prior to the skip stop plan 24.8 per cent of the damages paid were for injuries to passengers getting on and off cars. Contrary to the general belief, the increase in speed brought about by the elimination of stops has not been accompanied by an increase in the number of collisions, due probably to closer attention on the part of motormen and a knowledge on the part of drivers and pedestrians that at many street intersections cars do not stop.

At the time of the inauguration of higher schedule speeds and designated stops and since that time, special attention has been given by the traffic police to the prevention of accidents and this efficient effort has doubtless been reflected in the decreased accident hazard.

### Trail Car Operation.

There has been a steady increase in the use of trailer cars in Cleveland. The growth of this practice during the past four years is summarized in Table CXXXIV.

Table CXXXIV.— Car Miles.

| Month or Year | Motor Cars | Trailer Cars (Actual) | Total | Per Cent. Trailer Mileage of Total Mileage |
|---|---|---|---|---|
| | (*Thousands*) | (*Thousands*) | (*Thousands*) | |
| 1911 | 27,976 | 184 | 28,161 | 0.65 |
| 1912 | 28,832 | 461 | 29,294 | 1.57 |
| 1913 | 29,189 | 1,958 | 31,147 | 6.29 |
| 1914 | 30,187 | 3,559 | 33,745 | 10.55 |
| January 1915 | 2,375 | 343 | 2,717 | 12.61 |
| February 1915 | 2,160 | 323 | 2,483 | 13.00 |

TABLE CXXXII — AVERAGE ADDITIONAL WALK PER RIDE BY REASON OF THE SKIP STOP PLAN ON THE CLEVELAND RAILWAY CO.

| Line No. | Line Name | Total number of rides year 1914 thousands | Average distance between designated stops | Average distance between all former stops | Average added distance between stops | *Average additional walk per ride | Product number rides and added walk per ride | Line No. |
|---|---|---|---|---|---|---|---|---|
| 1 | St. Clair | 25,485 | 623 | 360 | 263 | 131.5 | 3,351,278 | 1 |
| 2 | Superior | 21,550 | 593 | 369 | 224 | 112.0 | 2,413,600 | 2 |
| 3 | Payne | 12,170 | 582 | 398 | 184 | 92.0 | 1,119,640 | 3 |
| 4 | Wade Park | 11,221 | 540 | 407 | 133 | 66.5 | 746,196 | 4 |
| 5 | Euclid | 27,664 | 565 | 339 | 226 | 113.0 | 3,126,032 | 5 |
| 6 | Euclid Heights | 8,121 | 520 | 370 | 150 | 75.0 | 609,075 | 6 |
| 7 | Cedar | 11,770 | 491 | 317 | 174 | 87.0 | 1,023,990 | 7 |
| 8 | Central | 5,981 | 452 | 264 | 188 | 94.0 | 562,214 | 8 |
| 9 | Scovill | 10,860 | 660 | 384 | 276 | 138.0 | 1,498,680 | 9 |
| 10 | Woodland | 17,357 | 542 | 348 | 194 | 97.0 | 1,683,629 | 10 |
| 11 | Kinsman | 9,040 | 637 | 379 | 258 | 129.0 | 1,166,160 | 11 |
| 12 | Union | 4,284 | 601 | 383 | 218 | 109.0 | 466,956 | 12 |
| 13 | Broadway | 15,865 | 658 | 370 | 288 | 144.0 | 2,284,560 | 13 |
| 14 | Union Depot | 3,370 | 336 | 336 | .......... | 0.0 | .......... | 14 |
| 15 | East 55th | 24,154 | 717 | 385 | 332 | 166.0 | 4,009,564 | 15 |
| 16 | East 79th | 4,549 | 517 | 337 | 180 | 90.0 | 409,410 | 16 |
| 17 | East 105th | 21,453 | 625 | 328 | 297 | 148.5 | 3,185,771 | 17 |
| 18 | Harvard — Dennison | 1,988 | 679 | 413 | 266 | 133.0 | 264,404 | 18 |
| 19 | South Brooklyn — West 25th Street | 14,274 | 612 | 387 | 225 | 112.5 | 1,605,825 | 19 |
| 20 | Clark — West 14th | 7,167 | 614 | 396 | 218 | 109.0 | 781,203 | 20 |
| 21 | Dennison — Fulton | 10,568 | 626 | 326 | 300 | 150.0 | 1,585,200 | 21 |
| 22 | Lorain | 14,636 | 622 | 367 | 255 | 127.5 | 1,866,090 | 22 |
| 23 | Bridge | 9,325 | 666 | 402 | 264 | 132.0 | 1,230,900 | 23 |
| 24 | Scranton | 4,356 | 642 | 376 | 266 | 133.0 | 579,348 | 24 |
| 25 | Fairfield | 2,262 | 646 | 457 | 189 | 94.5 | 213,759 | 25 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 26 | Detroit | 14,455 | 663 | 387 | 276 | 138.0 | 1,994,790 | 26 |
| 27 | Clifton | 6,166 | 729 | 410 | 319 | 159.5 | 983,477 | 27 |
| 28 | West 65th Street (Dennison to Edgewater) | 1,578 | 634 | 371 | 263 | 131.5 | 207,507 | 28 |
| | Total | 321,669 | 16,792 | 10,366 | 6,426 | 3,213.0 | 38,969,258 | |

| | |
|---|---|
| Weighted Additional Walk per Ride before adjustment | 121.13 ft. |
| Adjustment — Add 25 per cent | 30.28 ft. |
| Additional walk per Ride | 151.41 ft. |

* This Average Additional Walk per Ride has reference to all patrons who get off or on cars in central dischargal district. It has been found by making an analysis of representative radial lines that the limits of the ride for about 25 per cent of the people, making due allowance for the usual transfer points, are wholly without the central dischargal district where all stops are made. This percentage of the riders therefore is required to walk twice the average additional distance, or each rider is required to walk 1.25 times the average additional walk per ride or 151.41 ft as shown in the above tabulation.

TABLE CXXXIII—AVERAGE RATE OF SPEED ON ALL CITY LINES—THE CLEVELAND RAILWAY CO.

| Line | | Before the inauguration of the skip stop plan | | | After adoption of the skip stop plan | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | The Cleveland Railway Co. January 26, 1915 | | | |
| No. | Name | Municipal Traction Co. October, 1908 | Receivers March, 1910 | The Cleveland Ry. Co. January 1, 1912 | Base schedule | Rush schedule | Evening non-rush | Line No. |
| | | (Miles per hour) | (Miles per hour) | (Miles per hour) | (Miles per hour) | (Miles per hour) | (Miles per hour) | |
| 1 | St. Clair | 10.62 | 10.73 | 10.38 | 12.6 | 11.5 | 13.8 | 1 |
| 2 | Superior | 9.39 | 9.00 | 9.69 | 11.0 | 10.3 | 12.3 | 2 |
| 3 | Payne | 9.87 | 9.87 | 9.84 | 11.0 | 9.8 | 11.0 | 3 |
| 4 | Wade Park | 10.12 | 9.30 | 10.36 | 11.0 | 10.4 | 11.8 | 4 |
| 5 | Euclid | 9.78 | 9.68 | 9.68 | 11.4 | 10.4 | 11.4 | 5 |
| 6 | Euclid Heights | 10.70 | 10.19 | 10.19 | 11.0 | 10.3 | 11.0 | 6 |
| 7 | Cedar | 9.38 | 9.08 | 9.08 | 10.4 | 9.7 | 11.3 | 7 |
| 8 | Central | 9.09 | 9.09 | 9.00 | 10.6 | 9.6 | 11.3 | 8 |
| *9 | Scovill | 8.92 | 9.00 | 8.92 | 10.7 | 9.4 | 10.7 | 9 |
| *10 | Woodland | 8.57 | 8.57 | 8.47 | 9.9 | 9.3 | 9.9 | 10 |
| 11 | Kinsman | 8.10 | 8.74 | 8.74 | 10.5 | 9.9 | 11.5 | 11 |
| 12 | Union | 8.98 | 8.98 | 8.85 | 10.2 | 9.6 | 11.2 | 12 |
| 13 | Broadway | 9.97 | 9.85 | 9.85 | 11.0 | 10.4 | 12.1 | 13 |
| 14 | Union Depot | .......... | .......... | .......... | 8.0 | 8.0 | 8.0 | 14 |
| 15 | East 55th Street | 9.35 | 9.35 | 9.35 | 9.9 | 9.2 | 10.4 | 15 |
| 16 | East 79th Street | †........ | .......... | .......... | 9.3 | 8.4 | 10.3 | 16 |
| 17 | East 105th Street | 10.36 | 9.68 | 9.68 | 11.3 | 10.8 | 11.9 | 17 |
| 18 | Harvard–Dennison | †........ | .......... | .......... | 13.9 | 13.0 | 13.9 | 18 |
| *19 | South Brooklyn–West 25th Street | 8.92 | 9.00 | 8.92 | 10.9 | 10.2 | 10.9 | 19 |
| 20 | Clark West 14th Street | 8.52 | 8.73 | 8.73 | 10.9 | 10.2 | 10.9 | 20 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 21 | Dennison-Fulton | 9.40 | 10.36 | 9.75 | 10.7 | 10.3 | 11.9 | 21 |
| *22 | Lorain | 8.57 | 8.57 | 8.47 | 10.2 | 9.4 | 11.3 | 22 |
| 23 | Bridge | 9.40 | 9.70 | 9.70 | 11.0 | 10.3 | 12.3 | 23 |
| 24 | Scranton | 8.83 | 10.31 | 10.31 | 9.5 | 8.8 | 9.5 | 24 |
| 25 | Fairfield | 7.35 | 7.71 | 7.62 | 9.7 | 8.9 | 9.7 | 25 |
| 26 | Detroit | 10.84 | 10.71 | 10.45 | 11.2 | 10.6 | 11.8 | 26 |
| 27 | Clifton | 11.82 | 11.82 | 11.82 | 13.0 | 12.1 | 13.0 | 27 |
| 28 | West 65th Street | †........ | ........ | ........ | 10.5 | 10.5 | 10.5 | 28 |
| | Simple average | 9.45 | 9.50 | 9.50 | 10.76 | 10.08 | 11.27 | |
| | Weighted average | ........ | ........ | 9.60 | 10.67 | ........ | ........ | |

* These lines were formerly run as through town lines — Scovill, West 25th Street and Woodland Lorain Line. Accordingly the schedule speed in miles per hour is noted as the same for the two lobes, which are now operated separately.

† Not in operation.

TABLE CXXXV.—AVERAGE HEADWAY OF CARS* IN MINUTES—THE CLEVELAND RAILWAY CO.

| Line No. | Line Name | Observed at | 12 a. m. to 1 a. m. | 1 a. m. to 5 a. m. | 5 a. m. to 6 a. m. | 6 a. m. to 7 a. m. | 7 a. m. to 8 a. m. | 8 a. m. to 9 a. m. | 9 a. m. to 3 p. m. | 3 p. m. to 4 p. m. | 4 p. m. to 5 p. m. | 5 p. m. to 6 p. m. | 6 p. m. to 7 p. m. | 7 p. m. to 8 p. m. | 8 p. m. to 9 p. m. | 9 p. m. to 11 p. m. | 11 p. m. to 12 a. m. | Line No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | St. Clair....... | Square... | 12.0 | 60.0 | 2.3 | 1.2 | 1.4 | 2.0 | 4.0 | 3.3 | 1.9 | 1.2 | 3.0 | 4.0 | 5.0 | 5.0 | 6.0 | 1 |
| | | | .... | .... | *4.7* | *2.4* | *2.9* | *3.8* | .... | *5.0* | *3.8* | *2.4* | *3.8* | .... | .... | ..... | ..... | |
| 2 | Superior....... | Square... | 10.0 | 30.0 | 4.9 | 1.7 | 1.1 | 1.3 | 2.5 | 2.5 | 1.5 | .7 | 2.4 | 4.0 | 4.0 | 5.0 | 5.0 | 2 |
| | | | .... | .... | .... | *3.2* | *2.2* | *2.6* | *5.0* | *5.0* | *2.7* | *1.3* | *3.8* | *4.3* | .... | ..... | ..... | |
| 3 | Payne......... | Square... | 11.0 | 60.0 | 10.0 | 4.0 | 2.0 | 2.1 | 5.0 | 5.0 | 3.0 | 1.7 | 3.8 | 5.0 | 5.5 | 6.0 | 7.5 | 3 |
| | | | .... | .... | .... | *5.5* | *4.0* | *4.0* | .... | .... | *4.6* | *3.3* | *4.6* | .... | .... | ..... | ..... | |
| 4 | Wade Park.... | Square... | 10.0 | 60.0 | 6.0 | 4.3 | 2.3 | 2.6 | 6.0 | 5.0 | 2.7 | 1.4 | 4.3 | 5.0 | 5.5 | 6.0 | 7.5 | 4 |
| 5 | Euclid........ | Square... | 9.0 | 30.0 | 3.2 | 2.3 | 1.6 | 1.5 | 3.5 | 2.5 | 1.8 | 1.0 | 2.9 | 3.8 | 4.0 | 6.0 | 7.0 | 5 |
| | | | ... | .... | *4.6* | *4.3* | *3.0* | *2.9* | .... | *3.5* | *3.2* | *1.6* | *4.0* | *4.3* | *5.0* | ..... | ..... | |
| 6 | Euclid Heights. | Square... | 8.0 | ...., | 6.0 | 6.0 | 4.6 | 3.8 | 6.7 | 6.7 | 3.8 | 3.6 | 6.7 | 6.7 | 7.5 | 7.5 | 8.7 | 6 |
| 7 | Cedar......... | Square... | 15.0 | 60.0 | 7.5 | 4.0 | 2.1 | 2.2 | 4.8 | 4.7 | 2.9 | 1.6 | 4.0 | 4.7 | 5.0 | 6.0 | 7.5 | 7 |
| 8 | Central........ | E2-High.. | 15.0 | 60.0 | 6.0 | 5.0 | 3.3 | 5.5 | 6.0 | 6.0 | 5.5 | 3.2 | 6.7 | 7.0 | 7.5 | 8.0 | 8.0 | 8 |
| 9 | Scovill........ | STC-W9. | 11.0 | 60.0 | 6.0 | 3.0 | 2.3 | 3.1 | 6.0 | 6.0 | 3.5 | 1.9 | 4.6 | 6.0 | 6.0 | 7.0 | 7.0 | 9 |
| | | | .... | .... | .... | *3.8* | *4.6* | *4.6* | .... | .... | *4.3* | *3.8* | *5.0* | .... | .... | ..... | ..... | |
| 10 | Woodland..... | W. 3d.... | 8.0 | 30.0 | 3.3 | 1.9 | 1.9 | 2.6 | 4.0 | 3.7 | 2.3 | 1.2 | 3.3 | 5.0 | 5.5 | 6.0 | 6.0 | 10 |
| 11 | Kinsman...... | Pros,-Ont | 15.0 | 60.0 | 8.0 | 2.9 | 2.9 | 4.3 | 8.0 | 7.5 | 3.5 | 2.2 | 6.7 | 8.0 | 8.6 | 10.0 | 12.0 | 11 |
| | | | .... | .... | .... | *4.0* | *4.3* | *5.5* | .... | .... | *4.6* | *3.3* | .... | .... | .... | ..... | ..... | |
| 12 | Union......... | Champ-W 3d.... | 60.0 | 60.0 | 20.0 | 5.0 | 6.0 | 10.0 | 12.0 | 12.0 | 10.0 | 4.3 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12 |
| 13 | Broadway..... | Champ-W 3d.... | 15.0 | 60.0 | 6.0 | 2.0 | 1.8 | 3.0 | 6.0 | 5.0 | 2.0 | 1.3 | 4.3 | 6.0 | 6.0 | 7.0 | 8.0 | 13 |
| | | | .... | .... | .... | *4.0* | *3.5* | *4.6* | .... | *5.5* | *4.0* | *2.5* | *5.5* | .... | .... | ..... | ..... | |
| 14 | Union Depot... | Depot.... | 15.0 | 20.0 | 5.0 | 3.8 | 3.0 | 3.8 | 5.0 | 5.0 | 4.0 | 3.0 | 5.0 | 5.0 | 5.0 | 5.0 | 8.6 | 14 |
| 15 | East 55th Street | St. Clair–Marquard | 15.0 | *a*30.0 | 3.4 | 1.1 | 1.7 | 3.9 | 5.0 | 3.2 | 1.4 | 1.1 | 3.0 | 4.0 | 4.7 | 5.0 | 6.0 | 15 |
| | | | .... | .... | *3.8* | *1.5* | *2.4* | *4.0* | .... | .... | *2.0* | *1.5* | *3.5* | .... | .... | ..... | ..... | |
| 16 | East 79th St... | Woodland | 8.0 | .... | 6.7 | 4.0 | 3.5 | 5.0 | 7.0 | 7.0 | 4.6 | 3.3 | 3.5 | 6.0 | 6.7 | 8.0 | 8.0 | 16 |
| 17 | East 105th St.. | Depot.... | 15.0 | *b*60.0 | 3.0 | 2.3 | 2.0 | 2.4 | 5.0 | 4.6 | 2.0 | 1.5 | 1.9 | 2.0 | 3.2 | 5.0 | 5.5 | 17 |
| 18 | Harvard–Denison........ | Detroit... | 12.0 | .... | 9.0 | 8.6 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 8.6 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 18 |
| 19 | West 25th St... | W. 25–Clk | 20.0 | 60.0 | 2.6 | 1.5 | 1.7 | 3.5 | 6.0 | 3.3 | 1.5 | 1.5 | 6.0 | 6.0 | 6.0 | 6.0 | 8.0 | 19 |
| | | | .... | .... | *4.0* | *3.0* | *3.2* | *6.0* | .... | *4.0* | *2.9* | *2.7* | .... | .... | .... | ..... | ..... | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Clark Ave. W. 14thSt...... | W 25-Clk. | 20.0 | 60.0 | 4.3 | 3.0 | 3.3 | 4.3 | 4.0 | 3.7 | 2.9 | 2.4 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 20 |
| 21 | Dennison – Fulton........ | Square... | 30.0 | 60.0 | 2.7 | 1.5 | 2.0 | 4.0 | 6.0 | 4.3 | 3.5 | 1.5 | 5.0 | 6.0 | 7.5 | 7.5 | 7.5 | 21 |
| | | | .... | .... | .... | *1.8* | .... | .... | .... | .... | .... | *1.8* | .... | .... | .... | ..... | ..... | |
| 22 | Lorain....... | Square... | 10.0 | 30.0 | 5.0 | 2.3 | 1.6 | 3.5 | 5.7 | 5.0 | 2.2 | 1.3 | 3.5 | 5.0 | 6.0 | 7.0 | 8.6 | 22 |
| | | | .... | .... | *5.5* | *4.6* | *3.2* | *5.0* | .... | .... | *3.8* | *2.1* | *5.0* | *6.0* | *6.7* | ..... | ..... | |
| 23 | Bridge......... | Square... | 30.0 | 60.0 | 3.0 | 2.5 | 2.1 | 4.0 | 6.0 | 5.5 | 2.3 | 1.4 | 5.0 | 6.0 | 6.7 | 8.0 | 8.0 | 23 |
| | | | .... | .... | *4.8* | *5.0* | *4.3* | *5.0* | .... | .... | *3.3* | *2.7* | .... | .... | .... | ..... | ..... | |
| 24 | Scranton...... | Square... | ..... | .... | 3.5 | 3.0 | 3.0 | 5.0 | 10.0 | 8.6 | 3.2 | 3.0 | 8.6 | 10.0 | 10.0 | 12.0 | 12.0 | 24 |
| 25 | Fairfield....... | Square... | 15.0 | .... | 10.0 | 5.0 | 12.0 | 15.0 | 15.0 | 15.0 | 6.0 | 4.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 25 |
| 26 | Detroit........ | Square... | 15.0 | 30.0 | 4.3 | 2.2 | 1.7 | 2.0 | 4.0 | 4.0 | 2.3 | 1.1 | 3.5 | 4.0 | 5.5 | 6.0 | 6.7 | 26 |
| | | | .... | .... | *5.5* | *3.3* | *2.4* | *3.2* | .... | .... | *2.9* | *1.5* | .... | .... | .... | ..... | ..... | |
| 27 | Clifton........ | Square... | 60.0 | 60.0 | 10.0 | 7.5 | 4.6 | 4.0 | 10.0 | 10.0 | 5.0 | 3.3 | 8.6 | 10.0 | 15.0 | 15.0 | 20.0 | 27 |

* NOTE:— Figures in italics indicate headway between trains.
*a* 10.0 after 4.47 A. M.
*b* 5.0 after 4.43 A. M.

The principal effect of trail car operation is economy in labor. It is obvious that 25 per cent of the wages of platform men is eliminated through the operation of two cars by one motorman. In addition to this saving, which amounted in Cleveland in 1914 to about $11 200, there is a saving in time, resulting from the decreased time of loading and an increase in the track capacity due to the fact that there is no headway between the motor and the trailer car. By the use of trailers it has been possible on certain lines to increase the headway of trains to a considerable extent, as indicated in Table CXXXV. There appears to be in Cleveland, however, little objection on the part of the patrons to a schedule whereby two cars are operated together on a headway twice as great as would be the case in single car operation. The acquiescence of the traveling public in this economy was a considerable factor in the continuance of the 3-cent fare until the first of last September and will no doubt delay the time, should such come, when it will be necessary to again increase the fare. The headways shown in Table CXXXV are at the point of maximum frequency for each line. In outlying districts the time between cars is much greater due to short-routing.

EXTENSION OF LINES.

During the life of the ordinance under which The Cleveland Railway Co. is now operating, there has been a relatively small amount of track constructed. Such track as has been built however, has been so placed as to permit passengers to move from one point of the city to another without passing through the region of greatest traffic density. There is at the present time, a well defined need for certain extensions.[1]

It is particularly of interest that the building in Cleveland during the last two years has been with slight regard to the location of the single fare district. Some localities within the 3-cent area, particularly those along the recently constructed crosstown lines, have shown a considerable activity but no more so than other districts to which the fare is five cents. It will be recalled that the ordinance fares apply only within an area substantially equivalent to that within the city limits at the time of adoption of the ordinance. (Fig. 51.) There are a number of lines extending beyond the old city limits and on these lines a fare of five cents or more is charged. It appears that in these districts a 5-cent fare is not regarded as a particular disadvantage.

PAVING COSTS.

The ordinance provisions with respect to paving obligations are liberal as compared with many cities and have been liberally construed.[2] It is a rather difficult matter to measure the expenditures

[1] Recently a delegation of property owners requested a 3-mile extension of one of the suburban lines. The City Street Railroad Commissioner agreed to the extension provided the property owners contributed to the cost of construction 75 cents per foot of abutting land, or $1.50 per foot of track. At the present time something over $22,500 has been pledged and construction will be begun in the near future. The fare from the City to the point where the extension will be begun will be 3 cents. For each mile and one-half of the extension an additional fare of 3 cents will be charged, making a fare of 9 cents from the center of the City to the end of the new track.

[2] See Section 7 of Ordinance No. 16238-A passed by the Cleveland City Council Deember 19, 1909.

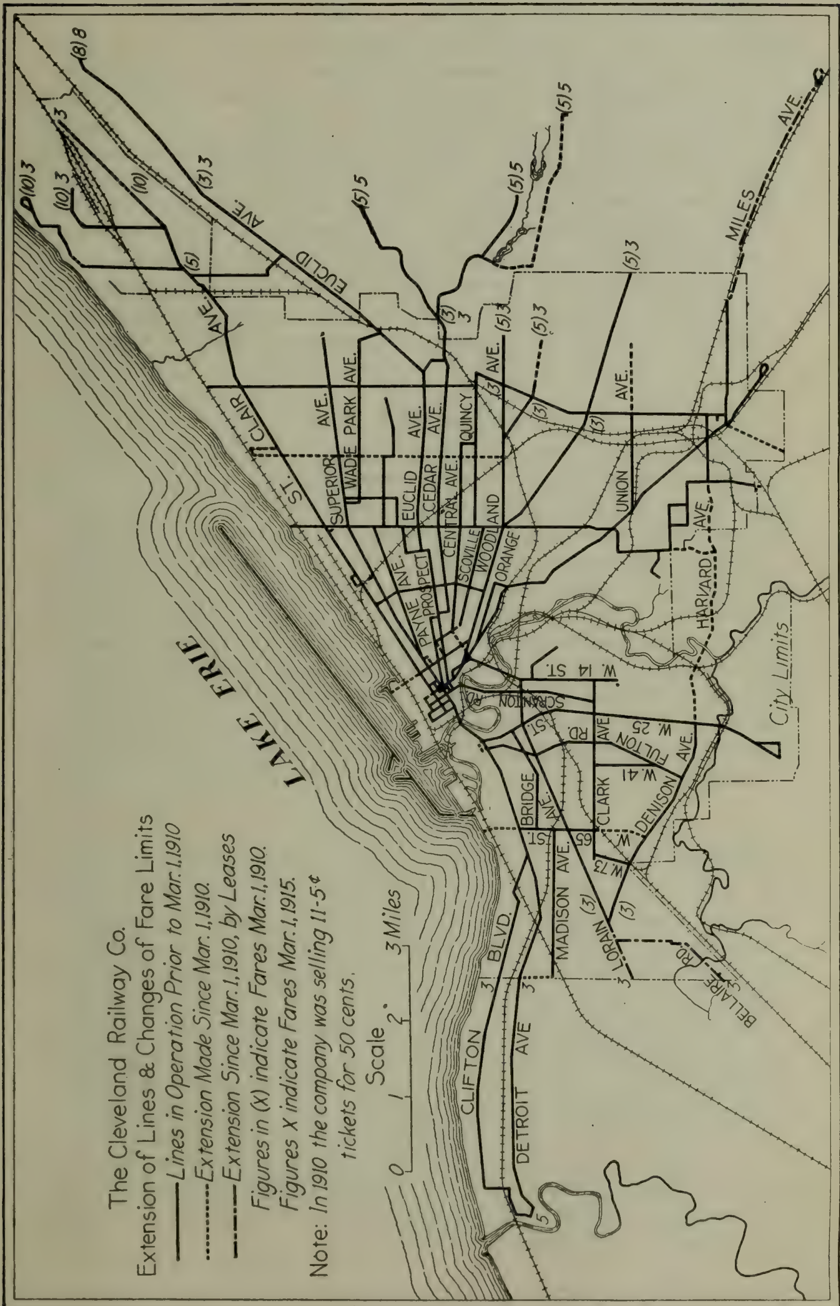

The Cleveland Railway Co.
Extension of Lines & Changes of Fare Limits
Lines in Operation Prior to Mar. 1, 1910
Extension Made Since Mar. 1, 1910.
Extension Since Mar. 1, 1910, by Leases
Figures in (X) indicate Fares Mar. 1, 1910.
Figures X indicate Fares Mar. 1, 1915.
Note: In 1910 the company was selling 11-5¢ tickets for 50 cents.
Scale
0
1
2
3 Miles
LAKE ERIE
EUCLID AVE
ST. CLAIR AVE.
SUPERIOR AVE.
WADE PARK AVE.
EUCLID AVE.
CEDAR AVE.
CENTRAL AVE.
QUINCY
SCOVILLE
WOODLAND AVE.
ORANGE
PAYNE AVE.
PROSPECT
UNION AVE.
HARVARD AVE.
MILES AVE.
W. 14 ST.
SCRANTON RD.
W. 25 ST.
FULTON RD.
W. 41
DENISON AVE.
CLARK AVE
W. 65 ST.
W. 73
BRIDGE AVE.
MADISON AVE.
LORAIN
BELLAIRE RD.
CLIFTON BLVD.
DETROIT AVE
City Limits

FIG. 51.

of The Cleveland Railway Co. for paving by a comparison with expentures of other companies for paving, due to differences in practice in distribution of paving costs as between operating expenses and charges to capital account, and the variety of franchise requirements under which various companies operate. In addition, it need scarcely be pointed out that paving costs show a very large fluctuation from year to year. Such a tabulation, however, recently prepared, discloses that about 17 per cent of the charges to Way and Structures of the Cleveland company for the last three years went for paving, while the average for 16 other companies was 23.5 per cent.

In this way, then, as in others, the coöperation of the public, more specifically the tax-payers in this case, has made it possible for the company to operate economically and has substantially assisted the continuation of low fares up to the present time.

### Traffic Regulation.

The track "hog" does not exist in Cleveland. The traffic ordinances of the city provide that vehicular traffic shall move as close to the right hand curb of each street as possible and the utmost vigilance is exercised to arrest and convict teamsters and autoists who appear to be encroaching upon the Company's tracks. This matter is handled directly by the Police Prosecutor and it is possible for teamsters to be arrested, convicted and fined for interference with street cars without the matter coming to the attention of the railway company. So careful apparently is the Police Department to coöperate with the City Street Railroad Commissioner in the promotion of high schedule speeds, that during two weeks of rather frequent riding in Cleveland but one instance was observed in which the motorman rang his gong to warn a driver off the track.

### Short Routing.

In addition to the economies effected by turning back practically all cars at the center of the city, considerable use of short-routing has been made wherever the relation of car capacity to number of passengers permitted. It is apparent from a study of the schedules that car capacities rather than headways have governed the movements of cars in the outlying districts.

From the termination of all lines in the center of the city, from the use of designated stops, from the increased speed and decreased accident hazard, from the use of two-car trains, from the policy with respect to extensions of lines, from low paving costs, from cordial coöperation on the part of the traffic police, and from the extensive use of short routing, the railway company has derived benefits of a very substantial nature, and these benefits must be kept in mind when any estimate of the success or failure of regulation in Cleveland and elsewhere is attempted.

## CHAPTER XXV.

### THE CLEVELAND EXPERIMENT (Continued)

### SERVICE RENDERED UNDER ORDINANCE REGULATION

Factors Affecting Service,—— Density of Traffic,—— Short-routing,—— Type of District Served,—— Types of Rolling Stock,—— Loading and Collection Practice,—— Car Movement as Assisted by Skip Stops, Trailer Cars, Near-side Stops, Traffic Ordinances, —— Transfer Points,—— Car Loading,—— Basis of Investigation, —— Measurements of Service as Compared with Standards Applied Elsewhere,—— Length of Ride,—— Riding Habits,—— Psychological Factors in Measuring Service,—— General Conclusions.

Rather extensive tests were made in May, 1915, in the City of Cleveland, with a view of determining as definitely as might be, the quality of the service furnished to street car patrons. The conclusions reached were based upon an examination of the car loading and upon certain other factors which will be discussed more fully in the following pages. The general conclusion reached was that with an unusually favorable distribution of residence and business districts, with a type of equipment more quickly loaded than is the case generally, with unusual coöperation on the part of the patrons in the matter of the method of fare collection, in the matter of passing quickly into and out of cars, and in the matter of the use of trailers and of designated stops, there is still, during both rush and non-rush periods on many lines, a degree of crowding and a percentage of standing passengers which places the standard of service in Cleveland below that specified by the Railroad Commission of Wisconsin, in its widely quoted service order in connection with The Milwaukee Electric Railway and Light Co., and in certain instances below that recommended in Chicago, by the Board of Supervising Engineers.

### FACTORS AFFECTING SERVICE.

The determining factors affecting service may be discussed under a number of sub-headings:

#### DENSITY OF TRAFFIC AS DISCLOSED BY PASSENGERS AND CAR MILES.

The general map of the Cleveland system facing page 382, Chap. XXIV, gives the respective location of various lines. The accompanying Table CXXXVI, indicates the distribution of car miles and the total number of rides on each of the various lines in Cleveland with the resulting density of traffic as measured in revenue and transfer passengers per car mile.

The data of Table CXXXVI when summarized appear as follows:

Passengers per car mile, 1914.

| | |
|---|---|
| Cash and Ticket Passengers | 6.83 |
| Transfer Passengers | 2.71 |
| Total Revenue Passengers | 9.54 |
| Dead Heads | 0.06 |
| Total Passengers | 9.60 |

Table CXXXVI.— Car Miles and Rides by Lines for Year Ended February 28, 1915.

| No. | LINES | Total rides | Revenue passengers including transfers | Car miles (Actual) | Revenue and transfer passengers per car mile |
|---|---|---|---|---|---|
| | *Name* | *Thousands* | *Thousands* | *Thousands* | |
| 1 | St. Clair | 25,387 | 25,284 | 2,662 | 9.50 |
| 2 | Superior | 21,492 | 21,385 | 1,910 | 11.20 |
| 3 | Payne | 12,011 | 11,974 | 1,013 | 11.82 |
| 4 | Wade Park | 11,292 | 11,228 | 1,208 | 9.29 |
| 5 | Euclid | 27,449 | 27,330 | 3,185 | 8.58 |
| 6 | Euclid Heights | 8,088 | 8,082 | 1,321 | 6.12 |
| 7 | Cedar | 11,764 | 11,718 | 1,009 | 11.61 |
| 8 | Central | 6,076 | 6,060 | 546 | 11.10 |
| 9 | Scovill | 10,686 | 10,647 | 1,024 | 10.40 |
| 10 | Woodland | 17,293 | 17,233 | 1,363 | 12.65 |
| 11 | Kinsman | 8,852 | 8,807 | 922 | 9.55 |
| 13 | Broadway | 15,649 | 15,538 | 1,973 | 7.88 |
| 15 | East 55th Street | 23,387 | 23,115 | 1,910 | 12.10 |
| 16 | East 79th (10 Mo.) | 5,642 | 5,615 | 441 | 12.74 |
| 17 | East 105th Street | 21,119 | 20,809 | 2,109 | 9.87 |
| 18 | Harvard-Dennison | 2,050 | 2,042 | 305 | 6.70 |
| 19 | West 25th Street | 14,965 | 14,863 | 1,372 | 10.84 |
| 20 | Clark West 14th Street | 6,361 | 6,318 | 727 | 8.70 |
| 21 | Dennison-Fulton | 10,553 | 10,514 | 1,179 | 8.92 |
| 22 | Lorain | 14,561 | 14,521 | 1,443 | 10.06 |
| 23 | Bridge | 9,331 | 9,267 | 1,078 | 8.59 |
| 24 | Scranton | 4,359 | 4,321 | 521 | 8.30 |
| 26 | Detroit | 14,259 | 14,139 | 1,752 | 8.07 |
| 27 | Clifton Boulevard | 6,192 | 6,164 | 1,130 | 5.46 |
| | Other Lines | 15,422 | 15,377 | 1,692 | 9.09 |
| | Total | 324,241 | 322,350 | 33,792 | 9.54 |

From an examination of figures covering the operation of electric railways in thirteen cities ranging in population from 260 000 to 1 900 000, Table CXXXVII has been prepared.

Table CXXXVII.— Traffic Density, 13 Cities

| ITEM | Cash and ticket passengers | Total passengers including transfer | Cash and ticket passengers | Total passengers including transfer |
|---|---|---|---|---|
| | *(Per car mile)* | *(Per car mile)* | *(Per capita)* | *(Per capita)* |
| Average | 6.00 | 8.41 | 267 | 376 |
| Maximum | 6.83 | 10.58 | 337 | 541 |
| Minimum | 4.66 | 6.35 | 223 | 255 |
| **Cleveland** | **6.83** | **9.54** | **330** | **461** |

The relatively high density of traffic in Cleveland is due to the cumulative effect of conditions of operation later enumerated. It summarizes, however, the prevailing reasons for low operating cost as compared with service rendered.

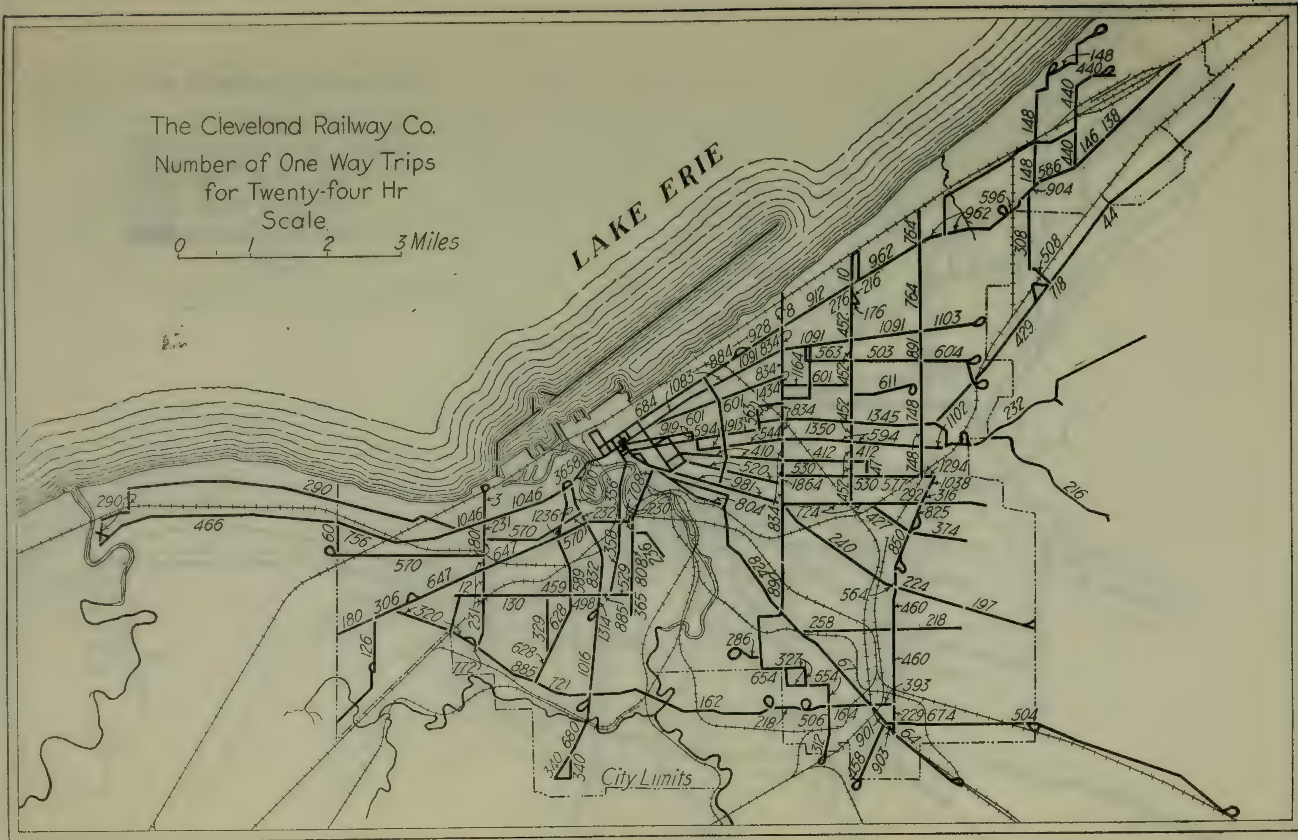

The Cleveland Railway Co.
Number of One Way Trips
for Twenty-four Hr
Scale
0 1 2 3 Miles
LAKE ERIE
City Limits

FIG. 52.

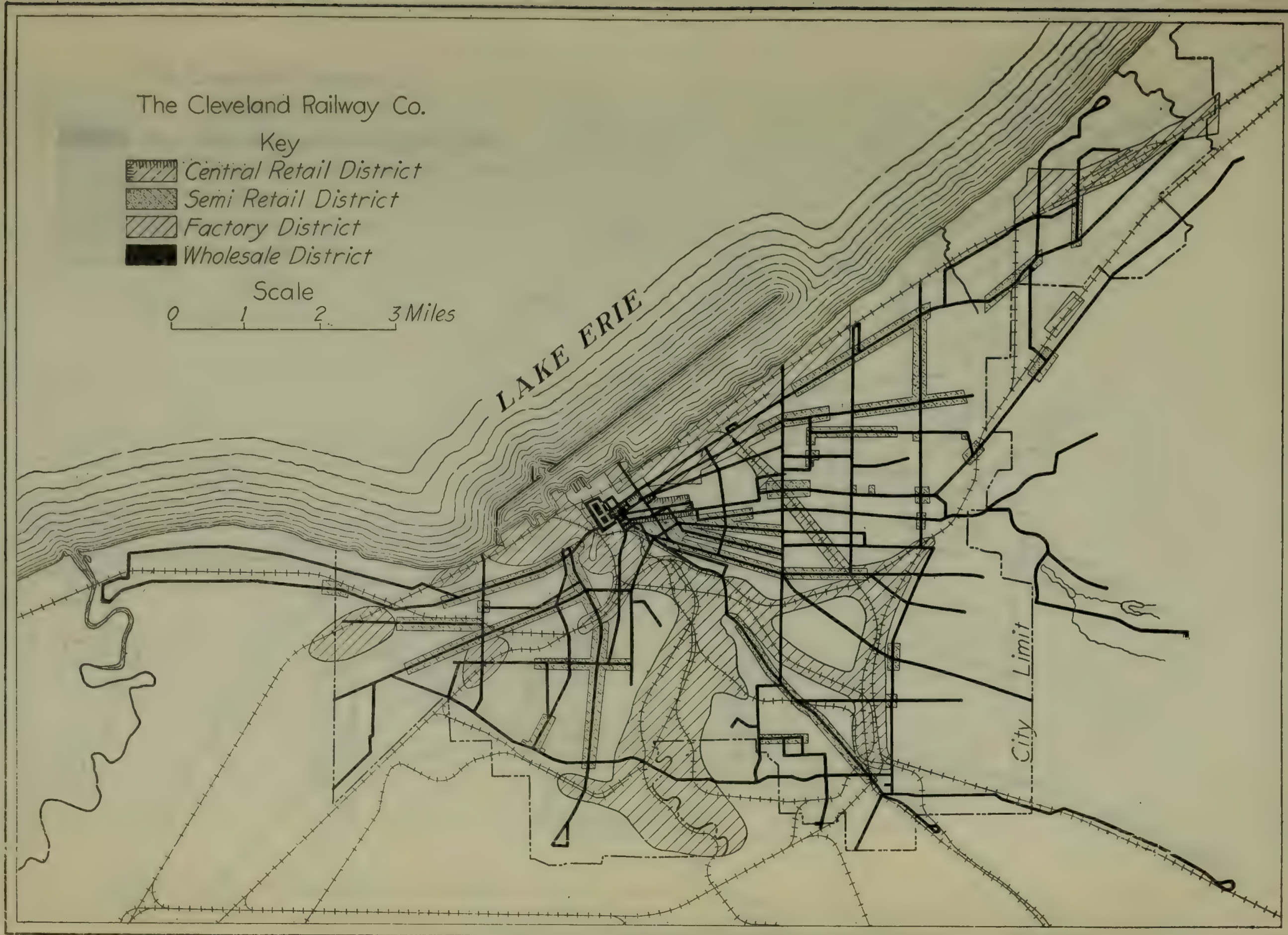



FIG. 53.— THE CLEVELAND RAILWAY CO.— CHARACTER OF TERRITORY SERVED.

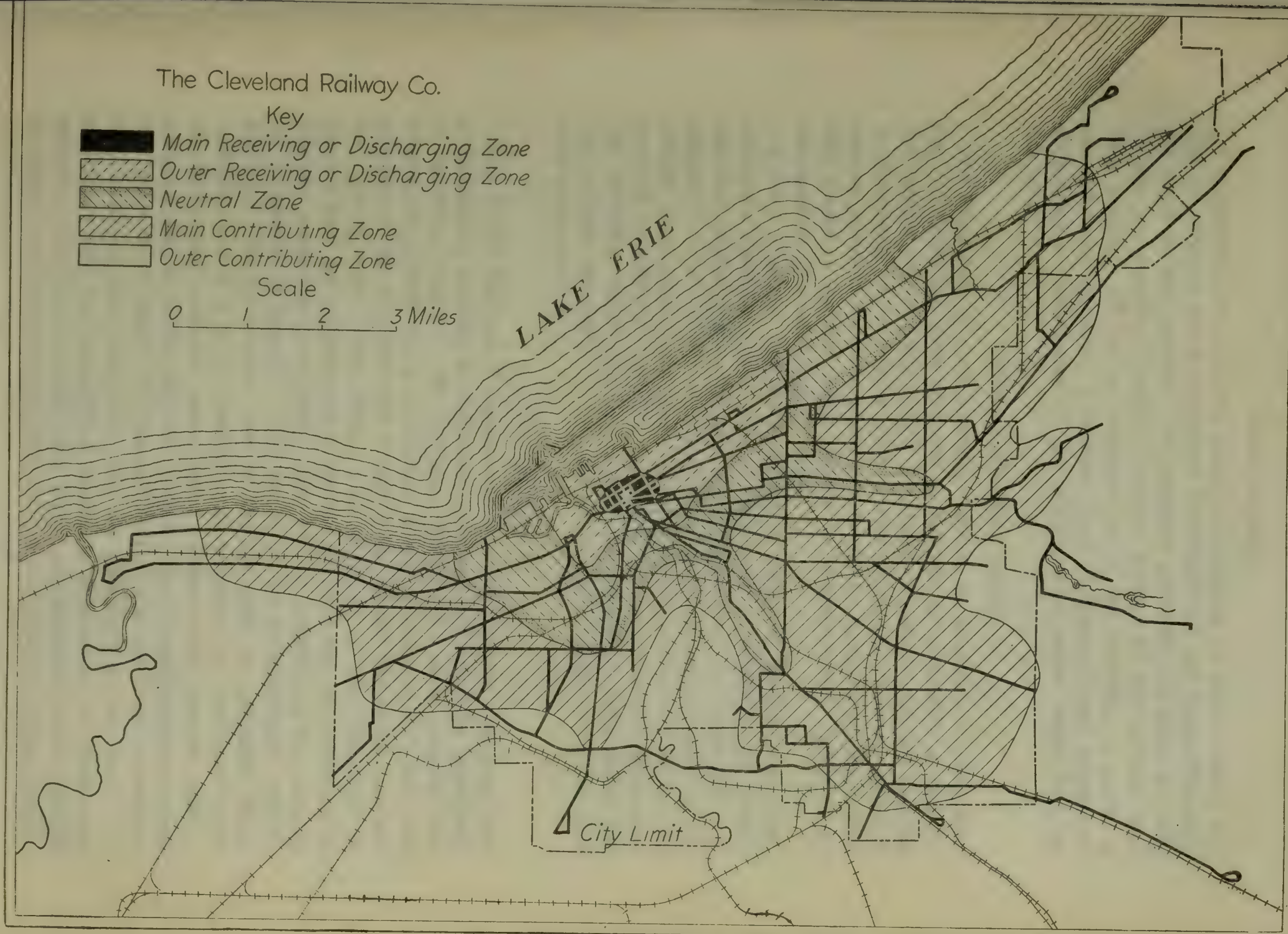



FIG. 54.— THE CLEVELAND RAILWAY CO.— TRAFFIC ZONES.

### Short Routing.

Considerable use has been made in Cleveland of short routing and Fig. 52, showing the geographical distribution of car miles, illustrates the effect of this practice. The numbers show the car miles per mile of line on weekday schedule for each portion of the various lines. This tapering off of car facilities to fit the decrease in traffic is unusual since in other American cities ordinances and regulations necessitate a continuation of car facilities even where traffic does not warrant.

### Type of District Served.

The character of the territory served is disclosed by the map, Fig. 53. This has been prepared to indicate as accurately as may be, the location of residence, retail, wholesale and manufacturing districts in Cleveland. It is worthy of note that there are extensive areas in various parts of the city which are gradually building up and which will doubtless expand more rapidly as transportation facilities are increased by the extension of lines.

A map, Fig. 54, has been drawn to show in general the traffic movement throughout the City of Cleveland by indicating the receiving and discharging areas and the neutral zone for each line. In passing, it is of interest to note that in many portions of the city the neutral zone is unusually wide. This no doubt is the chief reason for the lack of jitney competition in Cleveland. Contributing causes are low minimum fares and the evident unfriendliness with which the city officials interested in the success of the Ordinance would view such an innovation.

### Rolling Stock.

The Street Railroad Commissioner and the Railway Company have coöperated to produce several novel types of cars from the standpoint of carrying capacity. In the later designs the area available for passengers constitutes a somewhat larger percentage of the total capacity of the car than that obtaining in former Cleveland cars and the cars of many other cities. This tendency is best illustrated by one car built for experimental purposes, which it may be of interest to describe somewhat more fully than will be possible in the case of the equipment in general. This car is of the front-entrance, center-exit type. In the forward half of the car seats are arranged longitudinally leaving a large standing area, while in the rear part of the car there are transverse seats with a center aisle together with a marginal seat about the rear end and two short longitudinal seats near the center of the car. The forward half of the car is for passengers who have not paid their fare, and the rear half of the car is for passengers who have passed the conductor stationed at the center-exit and who have therefore paid their fare. All passengers leave through the center door, those leaving from the rear without the attention of the

conductor and those from the forward part of the car paying as they leave. During periods of heavy travel a large number of passengers can be taken on in this car in a very short time and since there is always the incentive of seats in the rear part of the car, a considerable proportion of the passengers automatically work past the conductor, paying their fare as they move and thus lessening the length of time necessary for stops. This type of car, locally known as "Pete's Pet", in recognition of the efforts of the present Street Railroad Commissioner, has much to commend it as a revenue producing unit, and the success with which its use has been attended in Cleveland will doubtless lead to the construction of more cars of a similar design.

The speed of loading is facilitated on very many of the cars both by the use of wide doors, the absence of steps, and the collection practice, which will be later discussed in detail.

Table CXXXVIII shows the number of cars of each type in service on January 1 for each of the last eight years. Table CXXXIX shows the capacity of each type of car, allowing 2, 3, and 4 sq. ft. per standing passenger. The seating capacity has been computed from detailed plans allowing approximately 19 in. per passenger, and standing room has been computed by deducting from floor space 9 in. knee room for seated passengers and by deducting further such areas as are not available for standing passengers on account of permanent fixtures, such as ventilators, ticket boxes and control apparatus. Table CXL gives similar data for a number of cars operated in other cities. Table CXLI gives detailed descriptive data of weight, wheel diameter, steps and doors of cars in use in Cleveland.

The above tables cover the greater part of the rolling stock now in service, and are shown as representing the types of cars toward which practice is tending in Cleveland. There were not available car plan prints for some of the older types and it is therefore not possible to make a comparison of the total car capacity in 1910, with that in 1915, on the basis of Tables CXXXVIII and CXXXIX. The company has, however, maintained an equipment register on a strictly comparable basis for many years and this register indicates that on March 1, 1910, the average seating and standing capacity of all revenue cars owned was 113.5 passengers and on March 1, 1915, was 129.8 passengers, an increase of 14 per cent. The revenue car miles during the year ended March 1, 1910, were 24 596 536 and during the year ended March 1, 1915, were 33 792 266, an increase of 37 per cent. The product of car miles and car capacity was therefore 57 per cent greater in 1915 than in 1910.

During this period the number of rides per year had increased from 195 388 101 to 324 241 265, or by 66 per cent. On the basis of seating capacity only, there were furnished in 1910 accommodations for 1 120 000 000 passenger miles and in 1915 for 1 700 000 000 passenger miles, an increase of 52 per cent as contrasted with an increase

TABLE CXXXVIII.— NUMBER OF CARS IN SERVICE — THE CLEVELAND RAILWAY CO.

| Type | Single or double truck | Jan. 1, 1908 | Jan. 1, 1909, and 1910 | Jan 1, 1911 | Jan. 1, 1912 | Jan. 1, 1913 | Jan. 1, 1914 | Jan. 1, 1915 |
|---|---|---|---|---|---|---|---|---|
| 14 and 15-bench combination | DT | 191 | 191 | 190 | 190 | 190 | 190 | 188 |
| 13-bench combination | DT | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 13-bench convertible trailer | DT | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13-bench convertible trailer | DT | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 28-ft. box 100 type | DTC | 17 | 16 | 16 | 16 | 16 | 16 | 16 |
| 28-ft. box 300 type | DT | 66 | 66 | 66 | 66 | 66 | 65 | 65 |
| 28-ft. box 700 type | DT | 100 | 100 | 99 | 99 | 99 | 99 | 99 |
| 28-ft. box 800 type | DT | 19 | 19 | 19 | 18 | 18 | 18 | 18 |
| 29-ft. box 100 type | DT | 67 | 67 | 67 | 67 | 67 | 67 | 66 |
| 30-ft. box 100 type | DT | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| 30-ft. box 300 type | DT | 34 | 34 | 34 | 34 | 34 | 33 | 33 |
| 30-ft. box 600 type | DT | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| 30-ft. box 800 type | DT | 81 | 81 | 81 | 81 | 81 | 81 | 81 |
| Pay-within 900 type | DTSC | 74 | 74 | 74 | 74 | 74 | 74 | 74 |
| 10-bench open motors | STO | 32 | 32 | 30 | 29 | 22 | 18 | ........ |
| 10-bench open trailers | STO | 58 | 58 | 57 | 56 | 38 | 37 | ........ |
| 9-bench open trailers | STO | 29 | 29 | 21 | 21 | ........ | ........ | ........ |
| 24-ft. box 2 type | STC | 1 | 1 | 1 | 1 | 1 | 1 | ........ |
| Pay-enter 900 type | DTSC | ........ | 1 | 26 | 26 | 26 | 26 | 26 |
| Pay-within 1,000 type | DTC | ........ | ........ | ........ | 1 | 1 | 53 | 53 |
| Closed trailers 2000 type | DTC | ........ | ........ | ........ | ........ | 94 | 300 | 300 |
| Center-entrance 101 type | DTC | ........ | ........ | ........ | ........ | ........ | 1 | 1 |
| Center-entrance 1,100 type | DTC | ........ | ........ | ........ | ........ | ........ | ........ | 50 |
| Center-entrance 1,150 type | DTC | ........ | ........ | ........ | ........ | ........ | ........ | 50 |
| Center-entrance 1,200 type | DTC | ........ | ........ | ........ | ........ | ........ | ........ | 65 |
| Total | ........ | 950 | 950 | 962 | 960 | 1,008 | 1,260 | 1,366 |

DT = Double truck.
DTC = Double truck closed.
DTSC = Double truck semi-convertible.
STO = Single truck open.
STC = Single truck closed.

TABLE CXXXIX.— CAR CAPACITY DATA FOR THE CLEVELAND RAILWAY CO'S CARS SHOWING FLOOR AREA APPORTIONMENT, AND ACTUAL SEATS, PLUS PASSENGERS STANDING ON BASIS OF TWO, THREE AND FOUR SQUARE FEET PER STANDING PASSENGER.

| TYPE OF CAR | Total floor area car body plus vestibule | Area devoted to seats including knee room | Area devoted to seats to total floor area | Number passengers seated | Area devoted to standing passengers | | | Number standing passengers on basis of — | | | Total passengers seated plus number standing on basis of — | | | Floor area per passengers seated | Floor area per passengers seated plus standing on basis of — | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total | Body | Vestibule | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. | | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. |
| | (sq. ft.) | (sq. ft.) | (Per ct.) | | (sq. ft.) | (sq. ft.) | (sq. ft.) | | | | | | | (sq. ft.) | | | |
| 28-feet P. E.; P. W. and P. L. cars | 239 | 110 | 46.1 | 36 | 129 | 74 | 55 | 64 | 43 | 32 | 100 | 79 | 68 | 3.43 | 2.39 | 3.02 | 3.51 |
| 29-feet P. W. cars | 275 | 113 | 41.2 | 38 | 162 | 100 | 62 | 81 | 54 | 40 | 119 | 92 | 78 | 2.97 | 2.31 | 2.98 | 3.52 |
| 30-feet P. E.; P. W. and P. L. cars | 245 | 116 | 47.4 | 40 | 129 | 79 | 50 | 64 | 43 | 32 | 104 | 83 | 72 | 2.90 | 2.35 | 2.71 | 3.40 |
| 400 type P. W. cars | 343 | 159 | 46.3 | 42 | 184 | 88 | 103 | 92 | 61 | 46 | 134 | 103 | 88 | 3.78 | 2.56 | 3.33 | 3.89 |
| 400 type P. E. cars | 304 | 153 | 50.3 | 43 | 151 | 99 | 52 | 75 | 50 | 37 | 118 | 93 | 80 | 3.55 | 2.57 | 3.26 | 3.80 |
| 500 type P. E.; P. W. and and P. L. cars | 346 | 133 | 38.5 | 45 | 213 | 117 | 103 | 106 | 71 | 53 | 151 | 116 | 98 | 2.95 | 2.22 | 2.98 | 3.53 |
| 33 type P. W. cars | 338 | 219 | 64.8 | 56 | 119 | 98 | *21 | 59 | 39 | 29 | 115 | 95 | 85 | 3.91 | 2.93 | 3.55 | 3.97 |
| 900 type P. E. cars | 344 | 188 | 54.7 | 57 | 156 | 104 | 52 | 78 | 52 | 39 | 135 | 109 | 96 | 3.29 | 2.54 | 3.15 | 3.58 |
| 900 type P. W. cars | 335 | 136 | 40.6 | 38 | 199 | 117 | 82 | 99 | 66 | 49 | 137 | 104 | 87 | 3.57 | 2.44 | 3.22 | 3.85 |
| 1,000 type P. W. cars | 323 | 189 | 58.5 | 57 | 134 | 75 | 59 | 67 | 44 | 33 | 124 | 101 | 90 | 3.31 | 2.60 | 3.19 | 3.59 |
| 1,110 type C. E. longitudinal and cross seats. | 324 | 218 | 67.4 | 59 | 106 | 106 | ..... | 53 | 35 | 26 | 112 | 94 | 85 | 3.93 | 2.89 | 3.45 | 3.82 |
| 1,100 type C. E. longitudinal seats only | 320 | 200 | 62.6 | 55 | 120 | 120 | ..... | 60 | 40 | 30 | 115 | 95 | 85 | 3.63 | 2.78 | 3.36 | 3.76 |
| 2,000 type C. E. trailers | 340 | 220 | 64.8 | 60 | 120 | 120 | ..... | 60 | 40 | 30 | 120 | 100 | 90 | 3.66 | 2.83 | 3.40 | 3.77 |
| Vestibuled cars Average for first 10 cars listed | 311 | 152 | 48.9 | 45 | 159 | 95 | 64 | 79 | 53 | 40 | 124 | 98 | 85 | 3.38 | 2.50 | 3.17 | 3.65 |
| Center-entrance cars Average for last 3 cars listed | 328 | 213 | 65.0 | 58 | 115 | 115 | ..... | 57 | 38 | 29 | 115 | 96 | 87 | 3.68 | 2.85 | 3.42 | 3.77 |

* Front entrance — center exit. P. E.= Pay enter type. P. W.= Pay within type. P. L.= Pay leave type. C. E.= Center-entrance type.

TABLE CXL.— CAR CAPACITY DATA FOR CITY SERVICE CARS OF RECENT DESIGN SHOWING AVAILABLE FLOOR AREA APPORTIONMENT IN REPRESENTATIVE CITIES, ACTUAL SEATS PLUS PASSENGERS STANDING ON BASIS OF TWO, THREE AND FOUR SQUARE FEET PER STANDING PASSENGER.

| Index to type car | Total floor area | Area devoted to seats including knee room | Area devoted seats to total floor area | Number of passengers seated | Area devoted to standing passengers | | | Number standing passengers on basis of — | | | Total passengers seated plus number standing on basis of— | | | Floor area per passenger seated | Floor area per passengers seated plus standing on basis of— | | | Index to type car |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total | Body | Vestibule | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. | | 2 sq. ft. | 3 sq. ft. | 4 sq. ft. | |
| | (sq. ft.) | (sq. ft.) | (Per cent) | | (sq. ft.) | (sq. ft.) | (sq. ft.) | | | | | | | (sq. ft) | | | | |
| 1...... | 307 | 164 | 53.5 | 42 | 143 | 71 | 72 | 71 | 48 | 36 | 113 | 89 | 78 | 3.90 | 2.73 | 3.45 | 3.94 | 1 |
| 2...... | 318 | 175 | 55.1 | 52 | 143 | 92 | 51 | 71 | 47 | 36 | 123 | 99 | 88 | 3.36 | 2.58 | 3.21 | 3.62 | 2 |
| 3...... | 320 | 169 | 52.8 | 40 | 151 | 79 | 72 | 75 | 50 | 38 | 115 | 90 | 78 | 4.23 | 2.78 | 3.56 | 4.10 | 3 |
| 4...... | 316 | 161 | 51.0 | 40 | 155 | 79 | 76 | 77 | 57 | 39 | 117 | 92 | 79 | 4.03 | 2.70 | 3.44 | 4.00 | 4 |
| 5...... | 337 | 181 | 53.8 | 52 | 156 | 78 | 78 | 78 | 52 | 39 | 130 | 104 | 91 | 3.48 | 2.59 | 3.24 | 3.71 | 5 |
| 6...... | 293 | 145 | 49.5 | 33 | 148 | 90 | 58 | 74 | 49 | 37 | 107 | 82 | 70 | 4.40 | 2.74 | 3.58 | 4.18 | 6 |
| 7...... | 280 | 146 | 52.2 | 48 | 134 | 74 | 60 | 67 | 44 | 33 | 115 | 92 | 81 | 3.04 | 2.43 | 3.04 | 3.46 | 7 |
| 8...... | 309 | 147 | 47.6 | 42 | 162 | 90 | 72 | 81 | 54 | 40 | 123 | 96 | 82 | 3.50 | 2.51 | 3.22 | 3.77 | 8 |
| 9...... | 300 | 170 | 56.7 | 47 | 143 | 77 | 66 | 71 | 47 | 36 | 118 | 94 | 83 | 3.62 | 2.54 | 3.19 | 3.62 | 9 |
| 10...... | 274 | 169 | 61.7 | 51 | 114 | 58 | 56 | 57 | 38 | 28 | 108 | 89 | 79 | 3.32 | 2.53 | 3.08 | 3.47 | 10 |
| 11...... | 289 | 185 | 64.0 | 53 | 104 | 104 | *... | 52 | 34 | 26 | 105 | 87 | 79 | 3.49 | 2.75 | 3.32 | 3.66 | 11 |
| 12...... | 283 | 183 | 64.7 | 56 | 112 | 84 | 28 | 56 | 37 | 28 | 112 | 93 | 84 | 3.27 | 2.53 | 3.04 | 3.37 | 12 |
| 13...... | 321 | 166 | 51.8 | 46 | 155 | 94 | 61 | 77 | 51 | 39 | 123 | 97 | 85 | 3.61 | 2.61 | 3.31 | 3.78 | 13 |
| 14...... | 275 | 134 | 48.7 | 36 | 141 | 69 | 72 | 70 | 47 | 35 | 106 | 83 | 71 | 3.72 | 2.59 | 3.32 | 3.87 | 14 |
| 15...... | 273 | 122 | 44.7 | 33 | 151 | 79 | 72 | 75 | 50 | 38 | 108 | 83 | 71 | 3.70 | 2.53 | 3.29 | 3.85 | 15 |
| 16...... | 331 | 188 | 56.8 | 48 | 133 | 83 | 50 | 66 | 44 | 33 | 114 | 92 | 81 | 3.92 | 2.90 | 3.60 | 4.08 | 16 |
| 17...... | 302 | 152 | 50.3 | 48 | 150 | 78 | 72 | 75 | 50 | 37 | 123 | 98 | 85 | 3.17 | 2.45 | 3.08 | 3.58 | 17 |
| 18...... | 342 | 183 | 53.5 | 44 | 159 | 79 | 80 | 79 | 53 | 39 | 123 | 97 | 83 | 4.16 | 2.78 | 3.53 | 4.12 | 18 |
| 19...... | 343 | 173 | 50.5 | 52 | 170 | 95 | 75 | 85 | 56 | 42 | 137 | 108 | 94 | 3.33 | 2.51 | 3.18 | 3.65 | 19 |
| Average. | 306 | 162 | 53.0 | 46 | 144 | 82 | 62 | 72 | 48 | 36 | 118 | 94 | 82 | 3.53 | 2.52 | 3.30 | 3.78 | ....Av |

* Mitten Type — Near Side Car.

TABLE CXLI. — THE CLEVELAND RAILWAY CO'S CARS — DESCRIPTIVE DATA.

| Type of Car | Motor or trailer | Weight | Wheel diameter | Step height | | | Car body | Doors | | | | Door operation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | Rail-step | Step to platform | Platform to floor | Entrance | | Exit | | |
| | | | | | | | | No. | Size | No. | Size | |
| | | (pounds) | (inches) | (inches) | (inches) | (inches) | (inches) | | | | | |
| 28-ft. P. E.; P. W. & P. L. cars | Motor | 42,680 | 33 | 39.25 | 18.50 | 12.50 | 8.25 | 1 | 3′–0″a | 1 | 2′–3″ | Manual |
| 29-ft. P. W. cars | Motor | 39,920 | 33 | 41.50 | 20.00 | 12.00 | 9.50 | 1 | 2′–9″ | 1 | 2′–3″ | Manual |
| 30-ft. P. E.; P. W. & P. L. cars | Motor | 44,400 | 33 | 39.25 | 18.50 | 12.50 | 8.25 | 1 | 3′–0″ | 1 | 2′–6″ | Manual |
| 400 type P. W. cars | Motor | 42,900 | Detail | not | given | on Blue | Print | 1 | 3′–9″ | 1 | 2′–0″ | ........... |
| 400 type P. E. cars | Motor | 42,900 | 33 | 40.00 | 16.00 | 14.00 | 10.00 | 1 | 4′–0″ | 1 | 2′–0″ | Manual |
| 500 type P. E.; P. W. & P. L. cars | Motor | 50,800 | 33 | 40.50 | 14.50 | 14.50 | 11.50 | 1 | 4′–0″ | 1 | 2′–3″ | Manual |
| 33 type P. W. cars | Motor | b44,680 | 26 | 32.00 | 12.75 | 9.63 | 9.62 | 1 | 3′–4″ | 2 | 2′–3″ | Pneumatic |
| 900 type P. E. cars | Motor | 48,500 | 33 | 40.75 | 16.88 | 14.50 | 9.37 | 1 | 4′–9″ | 1 | 2′–2″ | Manual |
| 900 type P. W. cars | Motor | 49,900 | 33 | 38.00 | 15.00 | 14.50 | 8.50 | 1 | 4′–5″ | 1 | 1′–11″ | Manual |
| 1,000 type P. W. cars | Motor | 47,940 | 33 | 42.25 | 15.25 | 13.50 | 13.50 | 1 | 4′–9″ | 1 | 2′–0″ | Manual |
| 1110 type C. E. longitudinal and cross seats | Motor | 44,280 | 26 | 32.00 | c12.69 | d12.00 | e7.31 | 1 | 2′–9″ | 1 | 2′–9″ | Pneumatic |
| 1100 type C. E. longitudinal seats only | Motor | 44,280 | 26 | 32.00 | c12.69 | d12.00 | e7.31 | 1 | 2′–9″ | 1 | 2′–9″ | Pneumatic |
| 2000 type trailers | Trailer | 26,200 | 22 | 29.44 | c15.44 | ...... | f14.00 | 1 | 2′–9″ | 1 | 2′–9″ | Pneumatic |

*a* This dimension is full clearance opening on rear platform.
*b* Weight without seats.
*c* Track to well. *d* Well to step. *e* Step to floor. *f* Well to floor.
P. E. = Pay-enter type.
P. W. = Pay-within type.
P. L. = Pay-leave type.
C. E. = Center entrance.

in passengers of 66 per cent and a probable greater increase in passenger miles, due to the building up of outlying parts of the city with a consequent increase in the average length of ride. It would appear from this comparison that the efforts made which have been successful in increasing the speed of operation have failed to keep the equipment as nearly that required by the traffic as it was five years ago, service having increased 57 per cent while traffic increased 66 per cent.

The Cleveland cars accelerate rapidly but it does not appear that, taking into account their weight, they are overmotored. Two other factors probably contribute to a considerable degree to the rapidity of acceleration. These are, first, an unusually complete and well arranged electrical distribution system by which it is possible to provide against excessive voltage drops, and the use on new cars of 26-in. wheels, which give a torque greater than is the case with the larger wheels which are somewhat more commonly in use. The maximum speed of the Cleveland cars appears to be about 17 miles per hour which is not high, but with rapid acceleration and speed in loading and with relatively few stops, the result is an unusually high schedule speed.

### LOADING AND COLLECTION PRACTICE

The present practices in loading and discharging passengers and collecting fares are designed to promote speed in handling passengers and to reduce expense and prevent loss in fare collection. A variety of methods are in use at the present time on different lines, the method used being apparently that best fitted to the class of traffic and type of car in use. The practice also varies on the same line at different times of the day and even between motor and trailer car on the same trip. The various practices are best illustrated by the following examples:

(*a*) The ordinary car with front and rear doors will be operated in-bound as a pay-enter car, the passenger entering by the rear door where the conductor is stationed and leaving by either door. On the out-bound trip, this car will be operated as a pay-as-you-leave car, passengers entering at either door and leaving by the rear door.

(*b*) The center-entrance cars are operated in-bound as pay-as-you-enter cars. The rear half of the car is regarded and treated as a platform and passengers may occupy that part part of the car without paying fare until they leave. If, after entering the rear part of the car, a passenger desires to go forward, he is required to pay his fare when he passes the conductor. These cars are operated out-bound as pay-as you-leave cars.

The result of this practice is that the passengers who leave the car at the Public Square and those who get on at that place are enabled to move through the doors with no delay, those alighting having paid

their fare upon entering the car and those boarding paying later as they leave.

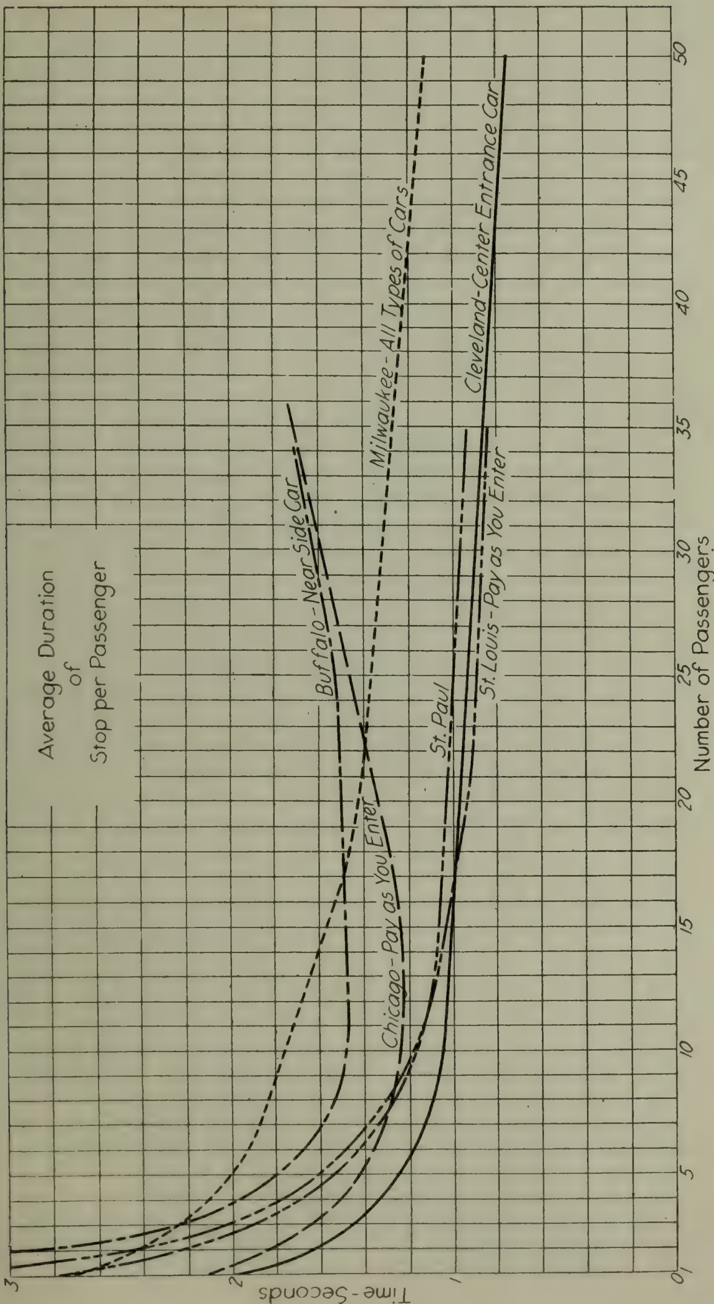
As a result of this complexity in practice, which a great number of operators in other cities would hesitate to apply, and against which, doubtless, a considerable amount of opposition would be raised in other cities by the traveling public, a high degree of speed is maintained in handling passengers. At the Public Square, observations taken with a stop watch indicate that 100 people frequently pass through the doors of a center-entrance car in three-quarters of a minute. Fig. 55 discloses the result of a large number of observations on speed of loading in Cleveland and for purposes of comparison curves are shown also from published reports on traffic conditions in other cities. The loading curve for Cleveland represents center-entrance cars only and the number of passengers shown includes those alighting as well as those boarding. Since the observations were largely confined to outbound rush-hour traffic and were made at the Public Square, they included relatively few passengers who were alighting. The curves shown for cars in other cities are taken from "A Report on Cincinnati Traffic Conditions" by R. W. Harris, (1912), and represent presumably only passengers boarding. The movement of passengers boarding other types of cars in Cleveland is less rapid than that for center-entrance cars and the rate of adoption of the latter type of car during the past few years is of interest. On January 1, 1913, 1914 and 1915, the percentage of center-entrance cars in service was respectively 10, 29 and 39.

## CAR MOVEMENT

The average speed of cars in Cleveland as computed from the current schedules is about 11 miles per hour. The schedule speed by lines has been shown in Table CXXXIII (Page 390) of the preceding chapter. The speed is at present a trifle less than it was a few months ago and it is probable that this has resulted partly from the resuming of certain stops which were originally eliminated and partly from the well known tendency of individuals and machines to slow up. An examination of the reports of 65 urban companies operating in other American cities, shows that the average speed, as obtained by dividing revenue car miles by revenue car hours, is 8.59 miles per hour. Values for the various companies range from 6.85 to 9.60 miles per hour.

The effect of skip-stops on car movement has already been pointed out and is again referred to as being one of the major factors contributing to rapid movement of cars. It is pertinent in this connection to again refer to the schedule speed on the various lines prior to and immediately subsequent to the inauguration of the designated stop scheme of operation as shown in Table CXXXIII (Page 390) of Chapter XXIV.

The use of trailer cars with the increased headway thus possible, is another factor which facilitates car movement. It is obvious that


Average Duration
of
Stop per Passenger
Number of Passengers
Time - Seconds
0
1
2
3
5
10
15
20
25
30
35
40
45
50
Buffalo - Near Side Car
Milwaukee - All Types of Cars
Cleveland - Center Entrance Car
Chicago - Pay as You Enter
St. Paul
St. Louis - Pay as You Enter

when cars are running within a few feet of each other, a delay to one will occasion a delay to a considerable number of cars, while if the cars are run on a greater headway, the delay to the first car is not transmitted to those following and the first car alone suffers. The average headway on certain of the heavy lines has been increased by the use of trailers, as has already been indicated in Table CXXXV (Page 392).

The short routing of cars has been practiced in Cleveland to an extent considerably greater than is general practice. The saving in car miles thereby effected is very large and while there is some inconvenience to those passengers who are obliged to take the car following to complete their journey, the plan is in the interest of economy and as such is of advantage to the riding public in general. A provision of the franchise minimizes "car to car" transferring by requiring passengers to board a car running to destination wherever possible.[1] The map (Fig. 56) shows the headway during the evening rush and also that indicated by the base schedules. This map indicates that certain localities contributing a considerable amount of business are not served with the frequency which a great many communities have come to believe they are entitled to.

Near side stops are employed in the downtown business district in Cleveland and elsewhere in the city at intersecting lines. Throughout the remainder of the city, the stops are determined not by the position of the intersecting streets, but are so placed as to equalize the distance walked by patrons under the designated stop scheme.

As has been previously mentioned, the traffic detail of the Cleveland police force is particularly efficient in avoiding delays to the street cars. Traffic police are stationed at 72 points throughout the city, from 8 a. m. to 7 p. m. Due to the peculiar conditions in Cleveland, the area of congestion is relatively small and this factor contributes, doubtless, to the possibility of the maintenance of high speed operation.

## NUMBER OF TRANSFER POINTS

The number of transfer points on the Cleveland lines is relatively small. On 295 miles of track they number but 88 in addition to the general transfer point at the Public Square. Compared with a number of other American cities, the transfer points per mile of track indicate that the layout of lines and general movements of traffic in Cleveland permit the serving of the public with a minimum of special work and with a minimum of delay and confusion at transfer points. Twenty-two companies operating approximately 5,000 miles of track, available for comparison with Cleveland, disclose a number of transfer points varying from 0.94 to 0.18 per mile of track, the weighted average being 0.37, as compared with 0.30 in Cleveland.

[1] If cars upon two or more routes are operated regularly along the same street, passengers who are able to reach their destination by one of said routes without transfer to another of said routes shall board a car upon the route reaching such destination and shall not be entitled to transfer thereto from any other route. (Sec. 22.)

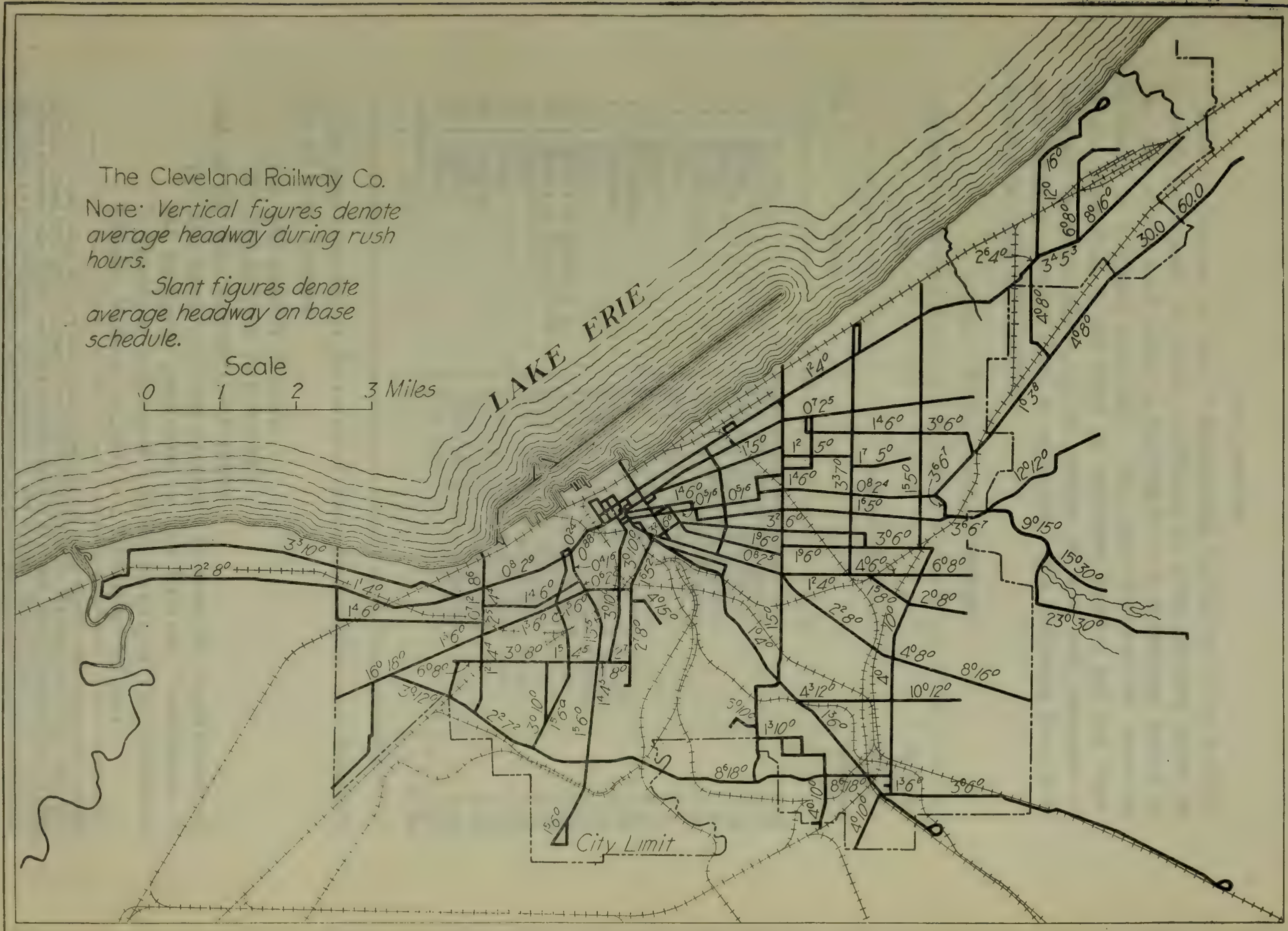



FIG. 56.— THE CLEVELAND RAILWAY CO.— AVERAGE HEADWAY.

### Car Loading.

With the purpose in view of determining the degree of car loading, a study was made of traffic conditions on lines carrying about 80 per cent of the total traffic in Cleveland for a continuous period of 18 hours on a typical week day.[1] This study involved the observing of all radial lines at the point of maximum loading and the determination by actual count, of the number of seats and passengers in each direction, from 6 a. m. to midnight. The following lines were included in these observations:

Table CXLII.— Lines Observed.

| Line — No. | Line — Name | Point of observation | Per cent of total rides, year ended December 31, 1914 |
|---|---|---|---|
| 1 | St. Clair | East 55th Street and St. Clair | 7.83 |
| 2 | Superior | East 12th Street and Superior | 6.62 |
| 3 | Payne | East 12th Street and Superior | 3.74 |
| 4 | Wade Park | East 22d Street and Prospect | 3.45 |
| 5 | Euclid | East 22d Street and Prospect | 8.49 |
| 6 | Euclid Heights | East 22d Street and Prospect | 2.74 |
| 7 | Cedar | East 22d Street and Prospect | 3.61 |
| 8 | Central | East 14th Street and Central | 1.84 |
| 9 | Scovill | East 14th Street and Central | 3.33 |
| 10 | Woodland | East 9th Street and Woodland Avenue | 5.33 |
| 11 | Kinsman | East 9th Street and Woodland Avenue | 2.78 |
| 12 | Union | East 9th Street and Woodland Avenue | 1.32 |
| 13 | Broadway | East 9th Street and Woodland Avenue | 4.87 |
| 19 | West 25th Street, S. B. | West 25th Street and Bridge Avenue | 4.38 |
| 20 | West 14th Street, Clark | Eagle and Central and Broadway | 2.20 |
| 21 | Dennison-Fulton | West 26th Street and Detroit | 3.25 |
| 22 | Lorain | West 25th Street and Bridge Avenue | 4.49 |
| 23 | Bridge | West 25th Street and Bridge Avenue | 2.86 |
| 24 | Scranton | West 3d Street and Prospect | 1.34 |
| 25 | Fairfield | Eagle, Central and Broadway | 0.80 |
| 26 | Detroit | West 28th Street and Detroit | 4.44 |
| 27 | Clifton | West 28th Street and Detroit | 1.89 |
| | Total | | 81.60 |

The data collected as the result of these observations were tabulated for all lines, showing:

(*a*) The number of seats

(*b*) The number of passengers

and on the same summary was shown

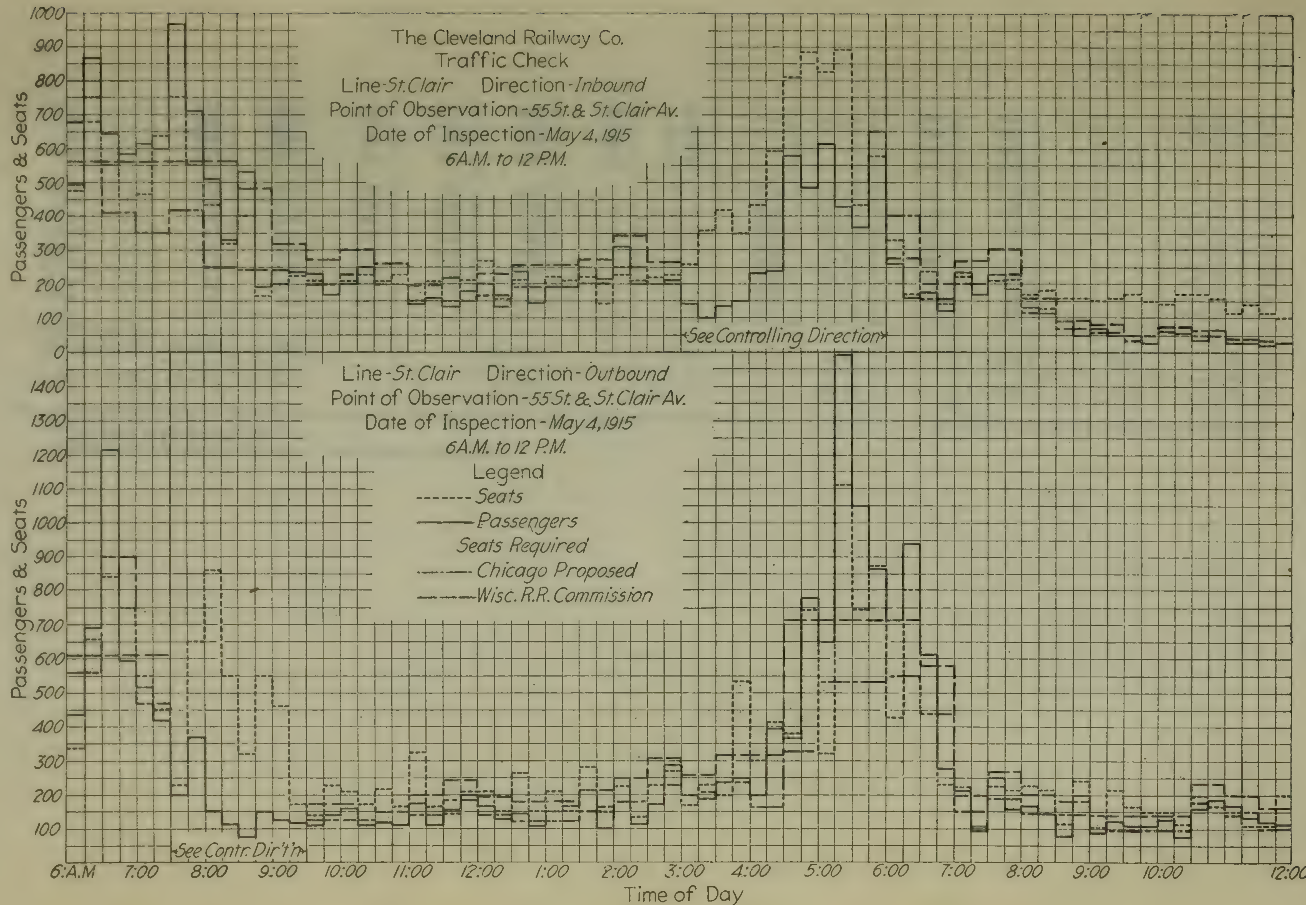
(*c*) The number of cars necessary to meet the requirements of the standards prescribed by the Railroad Commission of Wisconsin in connection with the service of The Milwaukee Electric Railway & Light Co., November 25, 1913

[1] The week days upon which these observations were made, were apparently typical as data taken from the Company's records for each line for the day upon which the traffic check thereon was made, and for the other days of the same week, indicate that the total car miles as observed were 99.56 per cent of the average daily car miles on these lines for the five days of the week in which the observations were made, and the rides as observed were 100.22 per cent of the daily average for that week.

TABLE CXLIII — MEASURE OF SERVICE — ST. CLAIR LINE OF THE CLEVELAND RAILWAY CO.

*Inbound May 4, 1915 — Observed at 55th and St. Clair.*

| Time | As observed in Cleveland | | | As required by railroad commission of Wisconsin standard (1913) | | Cleveland service: Below Wisconsin standard | | Cleveland service: Above Wisconsin standard | | As required by proposed Chicago standard (1914) | | Cleveland service: Below Chicago standard | | Cleveland service: Above Chicago standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Passengers | Seats* | Seats per 100 passengers | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars |
| **A. M.** | | | | | | | | | | | | | | | |
| 6–6:30 | 1,360 | 1,229 | 90 | 82 | 1,120 | ...... | ...... | 109 | 1.81 | 100 | 1,360 | 131 | 2.19 | .... | ..... |
| 7:00 | 1,230 | 1,018 | 83 | 91 | 1,120 | 102 | 1 70 | ...... | ...... | 67 | 824 | .... | .... | 194 | 3.23 |
| 7:30 | 1,212 | 1,104 | 91 | 92 | 1,120 | 16 | 0.27 | ...... | ...... | 57 | 703 | .... | .... | 407 | 6.79 |
| 8:00 | 1,672 | 1,310 | 79 | 67 | 1,120 | ...... | ...... | 190 | 3.17 | 50 | 836 | .... | .... | 474 | 7.90 |
| 8:30 | 873 | 755 | 89 | 133 | 1,120 | 365 | 6.08 | ...... | ...... | 57 | 497 | .... | .... | 376 | 6.26 |
| 9:00 | 726 | 574 | 79 | 133 | 965 | 391 | 6.51 | ...... | ...... | 67 | 486 | .... | .... | 88 | 1.46 |
| 9:30 | 478 | 544 | 114 | 133 | 635 | 91 | 1.51 | ...... | ...... | 100 | 478 | .... | .... | 66 | 1.10 |
| 10:00 | 406 | 380 | 93 | 133 | 539 | 159 | 2.65 | ...... | ...... | 100 | 406 | 26 | 0.43 | .... | ..... |
| 10:30 | 453 | 441 | 98 | 133 | 602 | 161 | 2.68 | ...... | ...... | 100 | 453 | 12 | 0.20 | .... | ..... |
| 11:00 | 393 | 439 | 112 | 133 | 522 | 83 | 1.40 | ...... | ...... | 100 | 393 | .... | .... | 46 | 0.77 |
| 11:30 | 305 | 363 | 119 | 133 | 405 | 42 | 0.70 | ...... | ...... | 100 | 305 | .... | .... | 58 | 0.96 |
| 12:00 | 316 | 369 | 117 | 133 | 420 | 51 | 0.85 | ...... | ...... | 100 | 316 | .... | .... | 53 | 0.88 |
| **P. M.** | | | | | | | | | | | | | | | |
| 12:30 | 345 | 424 | 123 | 133 | 458 | 34 | 0.56 | ...... | ...... | 100 | 345 | .... | .... | 79 | 1.31 |
| 1:00 | 385 | 365 | 95 | 133 | 512 | 147 | 2.45 | ...... | ...... | 100 | 385 | 20 | 0.33 | .... | ..... |
| 1:30 | 386 | 439 | 113 | 133 | 513 | 74 | 1.23 | ...... | ...... | 100 | 386 | .... | .... | 53 | 0.88 |
| 2:00 | 411 | 367 | 89 | 133 | 546 | 179 | 2.99 | ...... | ...... | 100 | 411 | 44 | 0.73 | .... | ..... |
| 2:30 | 509 | 437 | 86 | 133 | 676 | 239 | 3.99 | ...... | ...... | 100 | 509 | 72 | 1.20 | .... | ..... |
| 3:00 | 400 | 454 | 113 | 133 | 532 | 78 | 1.30 | ...... | ...... | 100 | 400 | .... | .... | 54 | 0.90 |
| 3:30 | 251 | 616 | 246 | See controlling direction. | | | | | | | | | | | |
| 4:00 | 288 | 769 | 267 | See controlling direction. | | | | | | | | | | | |
| 4:30 | 476 | 1,028 | 216 | See controlling direction. | | | | | | | | | | | |
| 5:00 | 1,068 | 1,697 | 159 | See controlling direction. | | | | | | | | | | | |
| 5:30 | 1,042 | 1,713 | 165 | See controlling direction. | | | | | | | | | | | |
| 6:00 | 1,019 | 1,010 | 99 | See controlling direction. | | | | | | | | | | | |



The Cleveland Railway Co.
Traffic Check
Line-St. Clair Direction-Inbound
Point of Observation-55 St. & St. Clair Av.
Date of Inspection-May 4, 1915
6 A.M. to 12 P.M.
Passengers & Seats
1000
900
800
700
600
500
400
300
200
100
0
See Controlling Direction
Line-St. Clair Direction-Outbound
Point of Observation-55 St. & St. Clair Av.
Date of Inspection-May 4, 1915
6 A.M. to 12 P.M.
Legend
Seats
Passengers
Seats Required
Chicago Proposed
Wisc. R.R. Commission
Passengers & Seats
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
See Contr. Dir't'n
6:A.M
7:00
8:00
9:00
10:00
11:00
12:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
12:00
Time of Day


Fig. 57.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6:30....... | 412 | 499 | 121 | 133 | 547 | 48 | 0.80 | ...... | ...... | 100 | 412 | .... | .... | 87 | 1.45 |
| 7:00....... | 298 | 379 | 127 | 133 | 396 | 17 | 0.30 | ...... | ...... | 100 | 298 | .... | .... | 81 | 1.35 |
| 7:30....... | 408 | 396 | 97 | 133 | 542 | 146 | 2.43 | ...... | ...... | 100 | 408 | 12 | 0.20 | .... | ..... |
| 8:00....... | 463 | 422 | 91 | 133 | 616 | 194 | 3.23 | ...... | ...... | 100 | 463 | 41 | 0.68 | .... | ..... |
| 8:30....... | 245 | 354 | 144 | 133 | 325 | ...... | ...... | 29 | 0.48 | 100 | 245 | .... | .... | 99 | 1.65 |
| 9:00....... | 135 | 312 | 231 | 133 | 179 | ...... | ...... | 133 | 2.21 | 100 | 135 | .... | .... | 177 | 2.95 |
| 9:30....... | 118 | 308 | 261 | 133 | 156 | ...... | ...... | 152 | 2.53 | 100 | 118 | .... | .... | 190 | 3.16 |
| 10:00....... | 71 | 327 | 461 | 133 | 94 | ...... | ...... | 233 | 3.88 | 100 | 71 | .... | .... | 256 | 4.26 |
| 10:30....... | 115 | 310 | 270 | 133 | 152 | ...... | ...... | 158 | 2.63 | 100 | 115 | .... | .... | 195 | 3.25 |
| 11:00....... | 98 | 325 | 332 | 133 | 130 | ...... | ...... | 195 | 3.25 | 100 | 98 | .... | .... | 227 | 3.78 |
| 11:30....... | 54 | 255 | 472 | 133 | 71 | ...... | ...... | 184 | 3.07 | 100 | 54 | .... | .... | 201 | 3.35 |
| 12:00....... | 48 | 211 | 439 | ...... | 63 | ...... | ...... | 148 | 2.46 | 100 | 48 | .... | .... | 163 | 2.71 |
| Total** 6 A. M. to 8:30 P. M. | 17,830 | 19,895 | ...... | ...... | 15,351 | ...... | 43.63 | ...... | 5.46 | ...... | 11,319 | .... | 5.96 | .... | 36.89 |
| 6 A. M. to 12 M. | 18,469 | 21,943 | ...... | ...... | 16,196 | ...... | 43.63 | ...... | 25.49 | ...... | 11,958 | .... | 5.96 | .... | 60.35 |

* Average seating capacity 60.
** Headway governs rather than traffic after 8:30 p. m.

TABLE CXLIII—(*Continued*)—MEASURE OF SERVICE—ST. CLAIR LINE OF THE CLEVELAND RAILWAY CO.
*Outbound May 4, 1915—Observed at 55th and St. Clair*

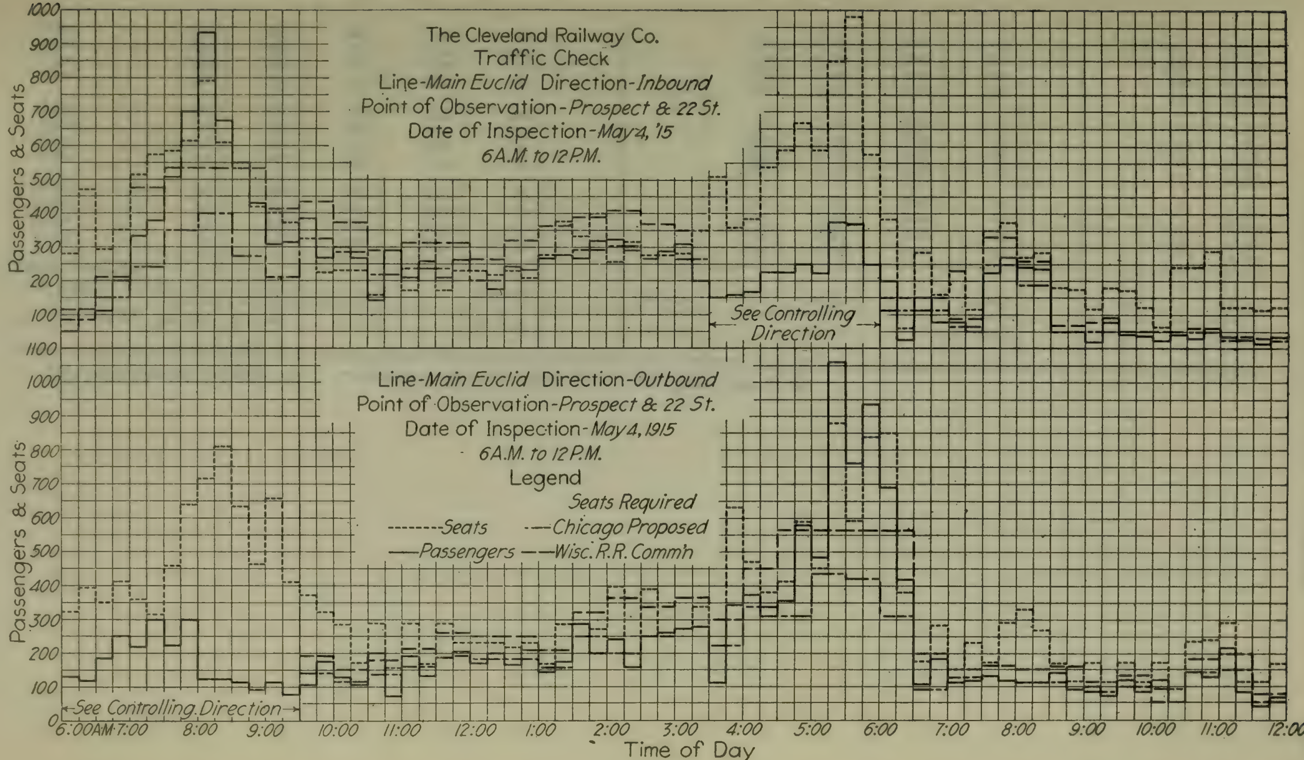
| Time | As observed in Cleveland | | | As required by railroad commission of Wisconsin standard (1913) | | Cleveland service | | | | As required by proposed Chicago standard (1914) | | Cleveland service | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Below Wisconsin standard | | Above Wisconsin standard | | | | Below Chicago standard | | Above Chicago standard | |
| | Passengers | Seats* | Seats per 100 passengers | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars |
| A. M. | | | | | | | | | | | | | | | |
| 6– 6:30....... | 1,127 | 993 | 88 | 108 | 1,211 | 218 | 3.63 | ...... | ...... | 100 | 1 127 | 134 | 2.23 | .... | ..... |
| 7:00....... | 1,808 | 1,595 | 88 | 67 | 1,211 | ...... | ...... | 384 | 6.40 | 100 | 1 808 | 213 | 3.55 | .... | ..... |
| 7:30....... | 936 | 1,008 | 108 | 130 | 1,211 | 203 | 3.38 | ...... | ...... | 100 | 936 | .... | .... | 72 | 1.20 |
| 8:00....... | 571 | 887 | 155 | See controlling direction. | | | | | | | | | | | |
| 8:30....... | 261 | 410 | 540 | See controlling direction. | | | | | | | | | | | |
| 9:00....... | 226 | 872 | 386 | See controlling direction. | | | | | | | | | | | |
| 9:30....... | 252 | 631 | 250 | See controlling direction. | | | | | | | | | | | |
| 10:00....... | 261 | 367 | 141 | 130 | 347 | ...... | ...... | 20 | 0.33 | 100 | 261 | .... | .... | 106 | 1.76 |
| 10:30....... | 268 | 380 | 142 | 130 | 356 | ...... | ...... | 24 | 0.40 | 100 | 268 | .... | .... | 112 | 1.87 |
| 11:00....... | 234 | 384 | 164 | 130 | 311 | ...... | ...... | 73 | 1.21 | 100 | 234 | .... | .... | 150 | 2.50 |
| 11:30....... | 294 | 496 | 169 | 130 | 391 | ...... | ...... | 105 | 1.75 | 100 | 294 | .... | .... | 202 | 3.36 |
| 12:00....... | 366 | 363 | 99 | 130 | 487 | 124 | 2.07 | ...... | ...... | 100 | 366 | 3 | 0.05 | .... | ..... |
| P. M. | | | | | | | | | | | | | | | |
| 12:30....... | 305 | 369 | 121 | 130 | 406 | 37 | 0.61 | ...... | ...... | 100 | 305 | .... | .... | 64 | 1.07 |
| 1:00....... | 263 | 424 | 161 | 130 | 350 | ...... | ...... | 74 | 1.23 | 100 | 263 | .... | .... | 161 | 2.68 |
| 1:30....... | 272 | 365 | 134 | 130 | 362 | ...... | ...... | 3 | 0.05 | 100 | 272 | .... | .... | 93 | 1.55 |
| 2:00....... | 329 | 439 | 133 | 130 | 438 | ...... | ...... | 1 | 0.01 | 100 | 329 | .... | .... | 110 | 1.83 |
| 2:30....... | 369 | 367 | 99 | 130 | 491 | 124 | 2.07 | ...... | ...... | 100 | 369 | 2 | 0.03 | .... | ..... |
| 3:00....... | 475 | 504 | 106 | 130 | 632 | 128 | 2.13 | ...... | ...... | 100 | 475 | .... | .... | 29 | 0.48 |
| 3:30....... | 389 | 397 | 102 | 130 | 517 | 120 | 2.00 | ...... | ...... | 100 | 389 | .... | .... | 8 | 0.13 |
| 4:00....... | 484 | 733 | 151 | 130 | 644 | ...... | ...... | 89 | 1.48 | 100 | 484 | .... | .... | 249 | 4.15 |
| 4:30....... | 488 | 709 | 145 | 130 | 649 | ...... | ...... | 60 | 1.00 | 67 | 327 | .... | .... | 382 | 6.36 |
| 5:00....... | 1,140 | 1,115 | 98 | 126 | 1,435 | 320 | 5.33 | ...... | ...... | 57 | 650 | .... | .... | 465 | 7.75 |
| 5:30....... | 2,141 | 1,419 | 66 | 67 | 1,435 | 16 | 0.26 | ...... | ...... | 50 | 1,070 | .... | .... | 349 | 5.81 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6:00 ....... | 1,891 | 1,602 | 85 | 76 | 1,435 | ...... | ...... | 167 | 2.78 | 57 | 1,078 | .... | .... | 524 | 8.73 |
| 6:30 ....... | 1,651 | 1,116 | 68 | 87 | 1,435 | 319 | 5.31 | ...... | ...... | 67 | 1,106 | .... | .... | 10 | 0.16 |
| 7:00 ....... | 882 | 671 | 76 | 133 | 1,173 | 502 | 8.37 | ...... | ...... | 100 | 882 | 211 | 3.51 | .... | ..... |
| 7:30 ....... | 314 | 322 | 103 | 133 | 418 | 96 | 1.60 | ...... | ...... | 100 | 314 | .... | .... | 8 | 0.13 |
| 8:00 ....... | 401 | 438 | 109 | 133 | 533 | 95 | 1.58 | ...... | ...... | 100 | 401 | .... | .... | 37 | 0.61 |
| 8:30 ....... | 311 | 437 | 141 | 133 | 414 | ...... | ...... | 23 | 0.38 | 100 | 311 | .... | .... | 126 | 2.10 |
| 9:00 ....... | 282 | 354 | 126 | 133 | 375 | 21 | 0.35 | ...... | ...... | 100 | 282 | .... | .... | 72 | 1.20 |
| 9:30 ....... | 210 | 312 | 149 | 133 | 279 | ...... | ...... | 33 | 0.55 | 100 | 210 | .... | .... | 102 | 1.70 |
| 10:00 ....... | 222 | 323 | 145 | 133 | 295 | ...... | ...... | 28 | 0.47 | 100 | 222 | .... | .... | 101 | 1.69 |
| 10:30 ....... | 207 | 270 | 130 | 133 | 275 | 5 | 0.08 | ...... | ...... | 100 | 207 | .... | .... | 63 | 1.05 |
| 11:00 ....... | 350 | 365 | 100 | 133 | 466 | 101 | 1.68 | ...... | ...... | 100 | 350 | .... | .... | 15 | 0.25 |
| 11:30 ....... | 298 | 270 | 91 | 133 | 396 | 126 | 2.10 | ...... | ...... | 100 | 298 | 28 | 0.46 | .... | ..... |
| 12:00 ....... | 238 | 312 | 131 | 133 | 317 | 5 | 0.08 | ...... | ...... | 100 | 238 | .... | .... | 74 | 1.23 |
| Total** 6 A. M. to 6:30 P. M. | 18,991 | 20,167 | ...... | ...... | 18,667 | ...... | 38.69 | ...... | 17.02 | ...... | 14,601 | .... | 9.37 | .... | 55.43 |
| 6 A. M. to 12 M. | 20,516 | 22,019 | ...... | ...... | 20,695 | ...... | 42.63 | ...... | 18.04 | ...... | 16,126 | .... | 9.83 | .... | 61.35 |

* Average seating capacity 60.
** Headway governs rather than traffic after 8:30 p. m.

TABLE CXLIV — MEASURE OF SERVICE — MAIN EUCLID LINE OF THE CLEVELAND RAILWAY CO.
*Inbound May 4, 1915 — Observed at Prospect and 22nd*

| TIME | As observed in Cleveland | | | As required by railroad commission of Wisconsin standard (1913) | | Cleveland service | | | | As required by proposed Chicago standard (1914) | | Cleveland service | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Below Wisconsin standard | | Above Wisconsin standard | | | | Below Chicago standard | | Above Chicago standard | |
| | Passengers | Seats* | Seats per 100 passengers | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars |
| A. M. | | | | | | | | | | | | | | | |
| 6– 6:30 | 167 | 748 | 448 | 133 | 222 | .... | .... | 526 | 9.56 | 100 | 167 | .... | .... | 581 | 10.56 |
| 7:00 | 312 | 650 | 208 | 133 | 416 | .... | .... | 234 | 4.25 | 100 | 312 | .... | .... | 338 | 6.14 |
| 7:30 | 713 | 1,088 | 153 | 133 | 948 | .... | .... | 140 | 2.55 | 67 | 478 | .... | .... | 610 | 11.09 |
| 8:00 | 1,205 | 1,198 | 99 | 89 | 1,076 | .... | .... | 122 | 2.22 | 57 | 687 | .... | .... | 511 | 9.29 |
| 8:30 | 1,607 | 1,399 | 87 | 67 | 1,076 | .... | .... | 323 | 5.87 | 50 | 804 | .... | .... | 595 | 10.82 |
| 9:00 | 974 | 951 | 98 | 110 | 1,076 | 125 | 2.27 | .... | .... | 57 | 555 | .... | .... | 396 | 7.20 |
| 9:30 | 625 | 772 | 124 | 133 | 831 | 59 | 1.07 | .... | .... | 67 | 419 | .... | .... | 353 | 6.42 |
| 10:00 | 653 | 561 | 86 | 133 | 868 | 307 | 5.58 | .... | .... | 100 | 653 | 92 | 1.67 | .... | .... |
| 10:30 | 564 | 464 | 82 | 133 | 750 | 286 | 5.20 | .... | .... | 100 | 564 | 100 | 1.82 | .... | .... |
| 11:00 | 435 | 451 | 104 | 133 | 578 | 127 | 2.31 | .... | .... | 100 | 435 | .... | .... | 16 | 0.29 |
| 11:30 | 471 | 523 | 111 | 133 | 626 | 103 | 1.87 | .... | .... | 100 | 471 | .... | .... | 52 | 0.95 |
| 12:00 | 475 | 405 | 85 | 133 | 631 | 226 | 4.11 | .... | .... | 100 | 475 | 70 | 1.27 | .... | .... |
| P. M. | | | | | | | | | | | | | | | |
| 12:30 | 403 | 451 | 112 | 133 | 535 | 84 | 1.53 | .... | .... | 100 | 403 | .... | .... | 48 | 0.87 |
| 1:00 | 479 | 439 | 92 | 133 | 637 | 198 | 3.60 | .... | .... | 100 | 479 | 40 | 0.73 | .... | .... |
| 1:30 | 545 | 655 | 120 | 133 | 724 | 69 | 1.25 | .... | .... | 100 | 545 | .... | .... | 110 | 2.00 |
| 2:00 | 590 | 730 | 124 | 133 | 784 | 54 | 0.98 | .... | .... | 100 | 590 | .... | .... | 140 | 2.54 |
| 2:30 | 613 | 577 | 94 | 133 | 815 | 238 | 4.33 | .... | .... | 100 | 613 | 36 | 0.65 | .... | .... |
| 3:00 | 554 | 554 | 100 | 133 | 736 | 182 | 3.31 | .... | .... | 100 | 554 | .... | .... | .... | .... |
| 3:30 | 516 | 635 | 123 | 133 | 686 | 51 | 0.93 | .... | .... | 100 | 516 | .... | .... | 119 | 2.16 |
| 4:00 | 303 | 867 | 286 | See controlling direction. | | | | | | | | | | | |
| 4:30 | 396 | 917 | 232 | See controlling direction. | | | | | | | | | | | |
| 5:00 | 479 | 1,255 | 262 | See controlling direction. | | | | | | | | | | | |
| 5:30 | 595 | 1,434 | 242 | See controlling direction. | | | | | | | | | | | |
| 6:00 | 615 | 1,554 | 253 | See controlling direction. | | | | | | | | | | | |



The Cleveland Railway Co.
Traffic Check
Line-*Main Euclid* Direction-*Inbound*
Point of Observation-*Prospect & 22 St.*
Date of Inspection-*May 4, '15*
*6 A.M. to 12 P.M.*
Line-*Main Euclid* Direction-*Outbound*
Point of Observation-*Prospect & 22 St.*
Date of Inspection-*May 4, 1915*
*6 A.M. to 12 P.M.*
Legend
*Seats Required*
--------*Seats*
-·-*Chicago Proposed*
——*Passengers*
——*Wisc. R.R. Comm'n*
See Controlling Direction
Passengers & Seats
Time of Day
6:00 AM
7:00
8:00
9:00
10:00
11:00
12:00
1:00
2:00
3:00
4:00
5:00
6:00
12:00


**FIG. 58.**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6:30....... | 219 | 441 | 202 | 133 | 291 | ...... | ...... | 150 | 2.73 | 100 | 219 | .... | .... | 222 | 4.04 |
| 7:00....... | 227 | 443 | 195 | 133 | 301 | ...... | ...... | 142 | 2.58 | 100 | 227 | .... | .... | 216 | 3.93 |
| 7:30....... | 124 | 346 | 279 | 133 | 164 | ...... | ...... | 182 | 3.31 | 100 | 124 | .... | .... | 222 | 4.04 |
| 8:00....... | 491 | 721 | 147 | 133 | 653 | ...... | ...... | 68 | 1.24 | 100 | 491 | .... | .... | 230 | 4.18 |
| 8:30....... | 377 | 557 | 148 | 133 | 501 | ...... | ...... | 56 | 1.02 | 100 | 377 | .... | .... | 180 | 3.27 |
| 9:00....... | 95 | 350 | 368 | 133 | 126 | ...... | ...... | 224 | 4.07 | 100 | 95 | .... | .... | 255 | 4.64 |
| 9:30....... | 106 | 291 | 274 | 133 | 140 | ...... | ...... | 151 | 2.75 | 100 | 106 | .... | .... | 185 | 3.36 |
| 10:00....... | 75 | 287 | 383 | 133 | 99 | ...... | ...... | 188 | 3.42 | 100 | 75 | .... | .... | 212 | 3.85 |
| 10:30....... | 64 | 296 | 462 | 133 | 85 | ...... | ...... | 211 | 3.84 | 100 | 64 | .... | .... | 232 | 4.22 |
| 11:00....... | 86 | 527 | 612 | 133 | 114 | ...... | ...... | 413 | 7.51 | 100 | 86 | .... | .... | 441 | 8.02 |
| 11:30....... | 45 | 236 | 524 | 133 | 59 | ...... | ...... | 177 | 3.22 | 100 | 45 | .... | .... | 191 | 3.47 |
| 12:00....... | 41 | 228 | 557 | 133 | 54 | ...... | ...... | 174 | 3.16 | 100 | 41 | .... | .... | 187 | 3.40 |
| Total! ** 6 A. M. to 8:30 P. M. | 15,727 | 21,786 | ...... | ...... | 15,925 | ...... | 38.34 | ...... | 35.33 | ...... | 11,158 | .... | 6.14 | .... | 89.79 |
| 6 A. M. to 12 M. | 16,239 | 24,001 | ...... | ...... | 16,602 | ...... | 38.34 | ...... | 63.30 | ...... | 11,670 | .... | 6.14 | .... | 120.75 |

* Average seating capacity, 55. ** Headway governs rather than traffic after 8:30 P. M.

TABLE CXLIV—(*Continued*)—MEASURE OF SERVICE—MAIN EUCLID LINE OF THE CLEVELAND RAILWAY CO.

*Outbound May 4, 1915—Observed at Prospect and 22d*

| TIME | As observed in Cleveland | | | As required by railroad commission of Wisconsin standard (1913) | | Cleveland service | | | | As required by proposed Chicago standard (1914) | | Cleveland service | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Below Wisconsin standard | | Above Wisconsin standard | | | | Below Chicago standard | | Above Chicago standard | |
| | Passengers | Seats* | Seats per 100 passengers | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars | Seats per 100 passengers | Seats | Seats | Cars | Seats | Cars |
| A. M. | | | | | | | | | | | | | | | |
| 6– 6:30 | 248 | 718 | 290 | See controlling direction. | | | | | | | | | | | |
| 7:00 | 436 | 761 | 174 | See controlling direction. | | | | | | | | | | | |
| 7:30 | 519 | 871 | 168 | See controlling direction. | | | | | | | | | | | |
| 8:00 | 525 | 1,100 | 210 | See controlling direction. | | | | | | | | | | | |
| 8:30 | 250 | 1,527 | 610 | See controlling direction. | | | | | | | | | | | |
| 9:00 | 210 | 1,099 | 524 | See controlling direction. | | | | | | | | | | | |
| 9:30 | 196 | 1,066 | 544 | See controlling direction. | | | | | | | | | | | |
| 10:00 | 291 | 696 | 239 | 133 | 387 | ...... | ...... | 309 | 5.62 | 100 | 291 | .... | .... | 405 | 7.36 |
| 10:30 | 241 | 460 | 191 | 133 | 321 | ...... | ...... | 139 | 2.53 | 100 | 241 | .... | .... | 219 | 3.98 |
| 11:00 | 279 | 451 | 162 | 133 | 371 | ...... | ...... | 80 | 1.45 | 100 | 279 | .... | .... | 172 | 3.13 |
| 11:30 | 329 | 464 | 141 | 133 | 438 | ...... | ...... | 26 | 0.47 | 100 | 329 | .... | .... | 135 | 2.45 |
| 12:00 | 397 | 523 | 132 | 133 | 528 | 5 | 0.09 | ...... | ...... | 100 | 397 | .... | .... | 126 | 2.29 |
| P. M. | | | | | | | | | | | | | | | |
| 12:30 | 376 | 464 | 124 | 133 | 500 | 36 | 0.65 | ...... | ...... | 100 | 376 | .... | .... | 88 | 1.60 |
| 1:00 | 386 | 451 | 117 | 133 | 513 | 62 | 1.13 | ...... | ...... | 100 | 386 | .... | .... | 65 | 1.18 |
| 1:30 | 325 | 460 | 142 | 133 | 432 | ...... | ...... | 28 | 0.51 | 100 | 325 | .... | .... | 135 | 2.45 |
| 2:00 | 494 | 709 | 143 | 133 | 657 | ...... | ...... | 52 | 0.94 | 100 | 494 | .... | .... | 215 | 3.91 |
| 2:30 | 405 | 600 | 148 | 133 | 739 | 139 | 2.53 | ...... | ...... | 100 | 405 | .... | .... | 195 | 3.55 |
| 3:00 | 516 | 651 | 126 | 133 | 686 | 35 | 0.64 | ...... | ...... | 100 | 516 | .... | .... | 135 | 2.45 |
| 3:30 | 556 | 620 | 112 | 133 | 739 | 119 | 2.16 | ...... | ...... | 100 | 556 | .... | .... | 64 | 1.16 |
| 4:00 | 460 | 747 | 162 | 133 | 612 | ...... | ...... | 135 | 2.45 | 100 | 460 | .... | .... | 287 | 5.22 |
| 4:30 | 688 | 854 | 124 | 133 | 915 | 61 | 1.11 | ...... | ...... | 100 | 688 | .... | .... | 166 | 3.02 |
| 5:00 | 940 | 1,002 | 107 | 121 | †1,136 | 134 | 2.44 | ...... | ...... | 67 | 630 | .... | .... | 372 | 6.76 |
| 5:30 | 1,546 | 1,332 | 86 | 73 | †1,136 | ...... | ...... | 196 | 3.56 | 57 | 881 | .... | .... | 451 | 8.20 |
| 6:00 | 1,697 | 1,431 | 84 | 67 | †1,136 | ...... | ...... | 295 | 5.36 | 50 | 848 | .... | .... | 583 | 10.60 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6:30 ....... | 1 108 | 1 232 | 111 | 103 | †1,136 | ...... | ...... | 96 | 1 74 | 57 | 631 | .... | .... | 601 | 10.93 |
| 7:00 ....... | 296 | 465 | 157 | 133 | 394 | ...... | ...... | 71 | 1.29 | 67 | 198 | .... | .... | 267 | 4.85 |
| 7:30 ....... | 237 | 388 | 164 | 133 | 315 | ...... | ...... | 73 | 1.33 | 100 | 237 | .... | .... | 151 | 2.74 |
| 8:00 ....... | 256 | 464 | 181 | 133 | 340 | ...... | ...... | 124 | 2.25 | 100 | 256 | .... | .... | 208 | 3.78 |
| 8:30 ....... | 237 | 599 | 253 | 133 | 315 | ...... | ...... | 284 | 5.16 | 100 | 237 | .... | .... | 362 | 6.58 |
| 9:00 ....... | 242 | 287 | 119 | 133 | 322 | 35 | 0.64 | ...... | ...... | 100 | 247 | .... | .... | 40 | 0.73 |
| 9:30 ....... | 176 | 287 | 163 | 133 | 234 | ...... | ...... | 53 | 0.96 | 100 | 176 | .... | .... | 111 | 2.02 |
| 10:00 ....... | 203 | 291 | 143 | 133 | 270 | ...... | ...... | 21 | 0.38 | 100 | 203 | .... | .... | 88 | 1.60 |
| 10:30 ....... | 181 | 232 | 128 | 133 | 124 | ...... | ...... | 108 | 1.96 | 100 | 181 | .... | .... | 51 | 0.93 |
| 11:00 ....... | 274 | 475 | 173 | 133 | 364 | ...... | ...... | 111 | 2.02 | 100 | 274 | .... | .... | 201 | 3.65 |
| 11:30 ....... | 302 | 407 | 135 | 133 | 402 | ...... | ...... | 5 | 0.09 | 100 | 302 | .... | .... | 105 | 1.91 |
| 12:00 ....... | 114 | 287 | 252 | 133 | 152 | ...... | ...... | 135 | 2.45 | 100 | 114 | .... | .... | 173 | 3.14 |
| Total** 6 A. M. to 8:30 P. M. | 14,444 | 22,205 | ...... | ...... | 13,746 | 591 | 10.75 | 1,908 | 34.66 | ...... | 9,661 | .... | .... | 5 402 | 98.19 |
| 6 A. M. to 12 M. | 15,936 | 24,471 | ...... | ...... | 15,614 | 626 | 11.39 | 2,341 | 42.52 | ...... | 11,158 | .... | .... | 6 171 | 112.17 |

* Average seating capacity, 55. ** Headway governs rather than traffic after 8:30 P. M. † See section 5, page 178, chapter XII.

(*d*) The same data based on standards of loading for the Chicago Surface Lines[1] as recently proposed by the Board of Supervising Engineers, Chicago Traction (1914)

There was also shown:

(*e*) The cars in addition to those now in service in Cleveland necessary to meet these standards

or

(*f*) The number of cars in service in excess of the number required by these standards.

Tables CXLIII and CXLIV show these tabulations for two typical radial lines. The summary of these studies of a number of individual lines is shown in Table CXLV to CXLVII, inclusive. Table CXLV gives the ratio of seats to passengers by lines during the maximum quarter-hourly and hourly periods of the morning and evening rush. Table CXLVI shows for the various lines, the additional cars required to meet the Wisconsin standard. Table CXLVII is similar, except that the arrangement is by hours instead of by lines. Under the proposed Chicago standard, there would be relatively little additional service required for the city as a whole. A number of lines, however, show deficiencies of one or more cars at various times during the day. Fig. 57 and 58 indicate graphically the relation of seats to passengers on the two typical lines shown in Tables CXLIII and CXLIV.

The results of this study of loading indicate that at the point of maximum loading during the maximum 15 min., the ratio of seats to passengers varied from 55 to 96 with an average for all lines observed of 72.1. For the maximum hour, the ratio of seats to passengers varied from 52 to 99 with an average for all lines observed of 78.9.[2] In other words, the standing passengers were 27.9 per cent during the maximum 15 min. and 21.1 per cent during the maximum hour.

The situation during non-rush hours, as is indicated by the 18-hour check, is not greatly different from that during rush hours. In this connection it is interesting to note (Table CXLVIII) the number of cars in service during each hour of the day. The operation of 3.7 times as many cars during the evening rush as during the middle of the day shows a concentration of service probably greater than that of any other urban system in this country, except certain rapid transit lines in New York and Chicago. From two to two and a half times as many cars are ordinarily run during the evening rush as during the middle of the day and when this ratio is increased to exceed three, it indicates either that exceptional service is furnished during the

[1] For a discussion of this and other proposed standards see Chap. XII.

[2] These conclusions are corroborated by a previous check made in October, 1914. It was then found that during one hour, from 4:50 to 5:50 p. m. for three consecutive days, the standing passengers constituted 27.5 per cent of the total number of passengers out-bound on all lines.

rush hours or that service during the middle of the day is considerably less than would be furnished by the average company.

An examination of the service on the individual lines shows that the uniformly heavy lines, such as St. Clair, Euclid, Broadway and Lorain are generally deficient during the non-rush hours on the basis of the standard of car loading prescribed by the Wisconsin Railroad Commission, but that this standard is met during the rush hours. On such lines as Fulton, Dennison, Detroit, Clifton, West 25th, Scranton, Woodland and West 14th, the service is generally bad during the evening rush and shows a degree of overcrowding not permitted under the Wisconsin requirements, or by generally accepted good practice.

TABLE CXLV — COMPARISON OF RATIO SEATS TO PASSENGERS, FOR MAXIMUM 15 MINUTE AND 1 HOUR PERIODS, DURING A. M. AND P. M. RUSH FOR ALL RADIAL LINES — THE CLEVELAND RAILWAY CO.

| LINE | | Ratio of seats to passengers, maximum 15 minute period | | Ratio of seats to passengers, maximum 1 hour period | |
|---|---|---|---|---|---|
| No. | Name | A. M. rush | P. M. rush | A. M. rush | P. M. rush |
| | | (*Per cent*) | (*Per cent*) | (*Per cent*) | (*Per cent*) |
| 1 | St. Clair | 69 | 74 | 93 | 76 |
| 2 | Superior | 78 | 83 | 89 | 91 |
| 3 | Payne | 69 | 74 | 91 | 96 |
| 4 | Wade Park | 76 | 93 | 82 | 93 |
| 5 | Euclid | 85 | 83 | 89 | 92 |
| 6 | Euclid Heights | 85 | 78 | 87 | 83 |
| 7 | Cedar | 91 | 73 | 92 | 82 |
| 8 | Central | 99 | 90 | 102 | 86 |
| 9 | Scovill | 114 | 67 | 90 | 85 |
| 10 | Woodland | 67 | 61 | 71 | 68 |
| 11 | Kinsman | 111 | 96 | 137 | 99 |
| 12 | Union | 88 | 54 | 89 | 76 |
| 13 | Broadway | 75 | 89 | 89 | 96 |
| 19 | South Brooklyn — West 25th Street | 72 | 70 | 74 | 79 |
| 20 | Clark Avenue — West 14th Street | 86 | 60 | 94 | 64 |
| 21 | Dennison-Fulton | 68 | 53 | 75 | 52 |
| 22 | Lorain | 88 | 72 | 95 | 76 |
| 23 | Bridge | 100 | 72 | 102 | 82 |
| 24 | Scranton | 65 | 55 | 70 | 60 |
| 25 | Fairfield | 52 | 66 | 66 | 69 |
| 26 | Detroit | 82 | 64 | 79 | 71 |
| 27 | Clifton | 79 | 60 | 67 | 60 |

Summing up the situation, it will be observed from Table CXLVI that additional service for the entire system is required as follows:

(*a*) 598 additional car hours per day by cars already in service.

(*b*) 51 additional car hours during the maximum period and requiring therefore additional facilities.

Inasmuch as the rate of fare charged in Cleveland is affected to a considerable extent, by any economies of operation which may be practiced, it is of interest to examine the effect on earnings of the standards of car loading in that city, as compared with those in operation elsewhere. Referring to Tables CXLIII and CXLIV, it will be seen that a certain amount of excess service is being rendered. It is evident, however, that this excess service could not, in general, be used to supplement the insufficient service elsewhere, both on account of the difficulty of running the same car on various lines at various times

Table CXLVI — Additional Car Hours Required by The Cleveland Railway Co. to Meet Various Service Standards

| Line | | Wisconsin Railroad Commission | | Chicago | |
|---|---|---|---|---|---|
| No. | Name | Inbound | Outbound | Inbound | Outbound |
| 1 | St. Clair | 44 | 43 | 6 | 10 |
| 2 | Superior | 6 | 25 | ........ | ......... |
| 3 | Payne | 5 | 10 | ........ | ......... |
| 4 | Wade Park | 14 | 7 | ........ | 1 |
| 5 | Euclid | 38 | 11 | 6 | ......... |
| 6 | Euclid Heights | 6 | 2 | ........ | ......... |
| 7 | Cedar | 6 | 6 | 1 | ......... |
| 8 | Central | ........ | 5 | ........ | ......... |
| 9 | Scovill | 10 | 9 | ........ | ......... |
| 10 | Woodland | 26 | 40 | 3 | 2 |
| 11 | Kinsman | 10 | 6 | 3 | ......... |
| 12 | Union | 3 | 8 | 1 | 1 |
| 13 | Broadway | 11 | 14 | 2 | 1 |
| 19 | South Brooklyn, West 25th Street | 9 | 22 | ........ | ......... |
| 20 | Clark Avenue, West 14th Street | 10 | 14 | 4 | ......... |
| 21 | Dennison-Fulton | 12 | 47 | 2 | 1 |
| 22 | Lorain | 20 | 19 | 2 | ......... |
| 23 | Bridge | 4 | 9 | ........ | ......... |
| 24 | Scranton | 2 | 12 | ........ | ......... |
| 25 | Fairfield | 3 | 10 | ........ | 2 |
| 26 | Detroit | 16 | 34 | 2 | 5 |
| 27 | Clifton | 14 | 27 | 7 | 13 |
| | Total | 269 | 380 | 39 | 36 |

of the day and also because of the fact that excess service in one direction is frequently necessary in order to provide the required service in the opposite direction on the return trip. It should also be borne in mind that over one-third of the "excess" shown occurs at times when headway requirements rather than loading requirements govern.

Summing up the results for the 22 lines studied, it appears that the particular departure from the Wisconsin Commission standard is during the transition period and during the middle of the day. In each of these places, it is, of course, possible to furnish the required

service with equipment which is at the present time available, inasmuch as the total number of cars in service during these periods is less than the number in service during the rush hour. With this in mind, it appears that in order to meet the Wisconsin Commission standard, it would be necessary to increase the off-peak car hours by 5.5 per cent. During the evening peak there would also be required about 4.3 per cent more cars than are now operated. These would presumably represent an increase in investment in cars, car housing facilities, power plant and other parts of the street railway plant which must be provided in proportion to the maximum car demand.

TABLE CXLVII — ADDITIONAL CAR HOURS REQUIRED BY THE CLEVELAND RAILWAY CO. TO MEET VARIOUS SERVICE STANDARDS

| PERIOD | Wisconsin Railroad Commission | | Chicago | |
|---|---|---|---|---|
| | Inbound | Outbound | Inbound | Outbound |
| 6– 7 A. M. | 19 | 4 | 6 | 10 |
| 7– 8 A. M. | 22 | 3 | ........ | 2 |
| 8– 9 A. M. | 69 | ........ | 7 | ......... |
| 9–10 A. M. | 26 | ........ | 5 | ......... |
| 10–11 A. M. | 24 | 2 | 3 | ......... |
| 11–12 A. M. | 10 | 7 | 2 | ......... |
| 12– 1 P. M. | 11 | 4 | 1 | ......... |
| 1– 2 P. M. | 35 | 2 | 5 | 1 |
| 2– 3 P. M. | 28 | 11 | 5 | ......... |
| 3– 4 P. M. | 5 | 24 | ........ | 3 |
| 4– 5 P. M. | ........ | 80 | ........ | 4 |
| 5– 6 P. M. | ........ | 51 | ........ | 1 |
| 6– 7 P. M. | 2 | 143 | 1 | 4 |
| 7– 8 P. M. | 13 | 16 | 2 | 3 |
| 8– 9 P. M. | 5 | 9 | 2 | 3 |
| 9–10 P. M. | ........ | 5 | ........ | 2 |
| 10–11 P. M. | ........ | 9 | ........ | 2 |
| 11–12 P. M. | ........ | 10 | ........ | 1 |
| TOTAL | 269 | 380 | 39 | 36 |

The cost of providing 5.5 per cent more car hours has been computed on the basis of the average cost per car hour, exclusive of those operating expenses which would presumably not be increased and exclusive of any and all charges for taxes and interest. The cost of furnishing 4.3 per cent additional service during the evening peak has been computed by including in addition to the costs enumerated above, those costs which vary with the traffic demand, including, of course, interest and taxes. The total costs thus obtained and necessary to meet the service standard promulgated by the Railroad Commission of Wisconsin amount to somewhat over $300 000. It may be possible, of course, in certain instances, to meet the Wisconsin standard by shifting of cars from one line to another throughout the day. The

very great practical difficulties of schedule making which arise when an attempt such as this is made, however, seem to indicate that no very great part of this $300 000 could be saved. Hence it is evident that since the measure of the necessity of an increased rate is but $200 000, the present service standards in Cleveland are the means of an economy at least equal to one step in the rates of fare, as outlined in the footnote to page 367, Chapter XXXIII.

TABLE CXLVIII — NUMBER OF CARS IN SERVICE BY HOURS, THE CLEVELAND RAILWAY CO.

| PERIOD | Motor | Trailer | Total |
|---|---|---|---|
| 12– 1 A. M. | 180 | ........ | 180 |
| 1– 2 A. M. | 52 | ........ | 52 |
| 2– 3 A. M. | 33 | ........ | 33 |
| 3– 4 A. M. | 32 | ........ | 32 |
| 4– 5 A. M. | 133 | 11 | 144 |
| 5– 6 A. M. | 481 | 136 | 617 |
| 6– 7 A. M. | 614 | 246 | 860 |
| 7– 8 A. M. | 682 | 271 | 953 |
| 8– 9 A. M. | 613 | 219 | 832 |
| 9–10 A. M. | 387 | 66 | 453 |
| 10–11 A. M. | 321 | 16 | 337 |
| 11–12 A. M. | 310 | 13 | 323 |
| 12– 1 P. M. | 310 | 13 | 323 |
| 1– 2 P. M. | 316 | 16 | 332 |
| 2– 3 P. M. | 324 | 19 | 343 |
| 3– 4 P. M. | 426 | 68 | 494 |
| 4– 5 P. M. | 765 | 276 | 1,041 |
| 5– 6 P. M. | 864 | 320 | 1,184 |
| 6– 7 P. M. | 701 | 213 | 914 |
| 7– 8 P. M. | 361 | 15 | 376 |
| 8– 9 P. M. | 321 | 6 | 327 |
| 9–10 P. M. | 263 | ........ | 263 |
| 10–11 P. M. | 248 | ........ | 248 |
| 11–12 P. M. | 241 | ........ | 241 |

## LENGTH OF RIDE

The average length of ride per passenger is, on account of its close relation to the rate of fare, of great importance in the present study. Seven representative radial lines were therefore selected, which in themselves contributed 52 per cent of the entire business, together with two of the heaviest crosstown lines, the total representing 56 per cent of the total passengers carried. The data for computing the average haul was obtained by riding the cars on these nine different lines during the evening rush period, when the general characteristics of the lines could be most accurately determined. From data collected by these observers, load curves were plotted for each of the lines and from the total passenger miles and the total passengers boarding the

cars upon the line observed, the average ride was determined. This has been found to be 2.61 miles as shown in Table CXLIX.

TABLE CXLIX.— AVERAGE PASSENGER RIDE ON THE CLEVELAND RAILWAY CO., WITHIN THE SINGLE FARE LIMIT

| Line | Average ride-miles |
|---|---|
| Broadway | 3.03 |
| Detroit | 2.14 |
| Euclid | 3.35 |
| St. Clair | 2.90 |
| Superior | 2.78 |
| West 25th Street | 2.69 |
| Woodland | 2.37 |
| East 105th Street | 2.38 |
| East 55th Street | 1.65 |
| Average ride weighted by number of rides | 2.61 |

The degree of discomfort to which patrons are subjected, considering all people that are obliged to stand as being subjected to discomfort, is indicated by the relation of the total miles travelled by standing passengers to the total passenger miles. It was found in this connection from the study of the load curves that the amount of standing (the length of standing ride being considered) was 16 per cent.

Inasmuch as the discomfort arising from standing increases more rapidly than the length of ride, there should be taken into account not only the total mileage of standing passengers, but also the average distance traveled by each standing passenger. A study of the load curves indicates that this is 1.49 miles, which distance may or may not result in serious discomfort to the standing passenger, depending upon various other factors which have been discussed in a general way in Chapter XIII.

## RIDING HABIT

The growth of population and industrial activity in Cleveland has been accompanied by a steady increase in the number of rides per capita. This growth in social and industrial importance has been such as to increase materially the extent of the floating population, which is reflected in the apparent riding habit. In spite of the fact, however, that the extent of riding in Cleveland is above the average, it is not obvious that the various changes in fare are reflected to any considerable extent in the amount of riding. During the past years there have been various changes of rate of fare in Cleveland and a study of these data does not indicate any marked degree of correlation between the rate of fare and the number of rides per capita. That topic was fully discussed in Chapter XIX and reference is there made to the extent of riding under various fares in Cleveland.

### Psychological Factors in Measuring Service

After examining all the physical factors, it is obvious that there is at work in Cleveland in addition to these, a factor of considerable moment but one which it is difficult to reduce to accurate measurement. The people of Cleveland have been told and generally believe that they have the best street railway system in the country, and, as the writer knows from experience, the most casual acquaintance both on the cars and in the streets in Cleveland is quick to boast of the excellence of the service and the satisfactory results of the Cleveland experiment.

There have been pointed out elsewhere (Chapter XIII) the results of an attempt to analyze the psychological factors in service, which included a study of popular opinion in Cleveland. It is unnecessary at this time to do more than to refer to the results of that study.

There are no standards of service which the average person is able to estimate or define accurately because satisfaction is psychological and largely independent of those elements of service which can be measured in accurate terms. Inasmuch as a preconceived idea as to the quality of service frequently determines opinion, the general reputation of a company is of great importance. The people of Cleveland have had pointed out to them for five years that low fares can continue only if accompanied by economies in operation and the political capital of the party in power has been based upon the belief of the people that "Cleveland service" is "good service." How great a factor this is may best be appreciated by those who have experienced a situation in which all the efforts of local politicians have been directed toward emphasizing the idea that whatever service the local street railway company rendered was poor service. A headway of 6-min. in a community where the company is popular is satisfactory, but a headway of 3-min. when the company is under attack is considered poor service. The same observation applies to standards of loading and other criteria of service. In a word, the coöperation of the patrons, fostered by the city government, is a material factor in the Cleveland situation, and much that may be complained of elsewhere is not regarded as poor service.

# CHAPTER XXVI

## THE CLEVELAND EXPERIMENT (Concluded)

## ACTUAL COST OF SERVICE UNDER ORDINANCE REGULATION

Financial Results for Two Ordinance Years Ended February 28, 1915,—— Deficiency in Allowances Under the Ordinance,—— Lack of Provision for Depreciation,—— Analysis of Balance Sheet of December 31, 1914,—— Unit Costs of Service,—— Paying Haul, —— Cost of Increasing Service to Wisconsin and Chicago Standards,—— Conclusions.

We have previously summarized the results of the investigation of the financial status of The Cleveland Railway Co. for the three years ended February 28, 1913, and it will be worth while here to look with considerable care at the details as shown in the income account for the two years since that date. There has been set up in Table CL an income account showing the actual receipts and disbursements of The Cleveland Railway Co. for the two ordinance years ended February 28, 1915. The income account, Table CLI, gives similar receipts but in place of actual disbursements there are shown the "allowances" under the Ordinance. One idea apparently back of the establishment of the interest fund was that the fluctuations of this fund from time to time would serve as an indication of the financial status of the company and of the necessity for increased fares or the opportunity for decreased fares.[1]

Table CLII gives a monthly comparison for the last two ordinance years of the corporate surplus and the interest fund. In examining this table and succeeding tables, it should be borne in mind that during the five years of operation of the ordinance, it has been possible to write off only $180 000 out of $700 000 of abandoned equipment, all of which went out of service during the first three years, and as the present value of that portion of the Cleveland Railway's plant in existence March 1, 1910, is obviously less than it was five years ago by a very considerable amount, the discrepancy between the actual "expenditures" for Maintenance, Renewals and Depreciation and the "allowance" for these expenses fails very materially to indicate the amount by which the ordinance allowance has proven to be insufficient.

Aside from the wasting of physical property, it is evident from Tables CL, CLI, and CLII that the operation of The Cleveland Railway Co. has failed to yield 6 per cent on about 70 per cent of the investment (see foot-note page 368, Chapter XXIII) and that while under the provisions of accounting necessitated by the ordinance there has been a decrease in the interest fund during the last two years of $219 012.

[1] Another function of the interest fund was to assure the bond holders and stockholders prompt payment of interest on their securities and taxes on their property. This provision grew out of the lease of the Municipal Traction Company referred to in Chapter XXII. The failure to pay the rental which the Municipal Traction Co. had agreed to pay to the stockholders of The Cleveland Railway Co. was one of the grounds for the forfeiture of the lease. The interest fund serves to make certain that there shall always be in the hands of the company at least $300,000 in cash applicable to the payment of interest and taxes. The interest fund and the sliding scale of fares together constitute what is sometimes called the "guaranty" of the city of Cleveland.

there has actually been a deficit of $379 778. Since September 1, 1914, when under the terms of the ordinance it became necessary, due to the status of the interest fund, to increase rates, there has been an increase in the interest fund of $92 146 but with labor conditions

Table CL — Income Account — The Cleveland Railway Company — Based on Receipts and Expenditures

| Item | Year ended Feb. 28, 1914 | Year ended Feb. 28, 1915 |
|---|---|---|
| **Operating revenue, total** | $7,213,652 54 | $7,801,490 96 |
| Total passenger revenue | 7,042,761 25 | 7,621,366 92 |
| Passenger fares | 7,016 793 38 | 7,247,252 48 |
| Employees fares | 25,967 87 | 30,390 69 |
| Transfers | ............ | 343,723 75 |
| Other transportation revenue | 111,122 74 | 97,338 06 |
| Other operating revenue | 59,768 55 | 82,785 98 |
| **Operating expenses, total** | 5,444,832 34 | 5,872,406 01 |
| Total maintenance | 1,715,834 94 | 1,958,228 76 |
| Maintenance, way and structures | 962,856 30 | 1,165,337 99 |
| Maintenance of equipment | 746,451 01 | 658,380 85 |
| Maintenance of power plants | 6,527 63 | 134,509 92 |
| Total operation | 3,728,997 40 | 3,914,177 25 |
| Traffic | 738 55 | 898 39 |
| Operation of power plant | 679,234 66 | 718,816 64 |
| Conducting transportation | 2,360,271 39 | 2,406,429 12 |
| General and miscellaneous | 688,752 80 | 788,033 10 |
| Accidents | 318,594 20 | 393,857 87 |
| Insurance | 26,949 65 | 26,435 74 |
| City commissioner | 41,258 86 | 40,040 53 |
| Other | 301,950 09 | 327,698 96 |
| **Net operating revenue** | 1,768,820 20 | 1,929,084 95 |
| **Non-operating revenue, total** | 35,714 57 | 48,240 83 |
| Rentals | 3,565 78 | 4,049 34 |
| Interest | 32,148 79 | 44,191 49 |
| **Gross income** | 1,804,534 77 | 1,977,325 78 |
| **Fixed charges, total** | 752,312 11 | 907,786 38 |
| Rentals | ............ | ............ |
| Taxes | 450,453 44 | 470,056 59 |
| Interest, funded debt | 274,750 00 | 274,435 96 |
| Interest, floating debt | 22,108 65 | 14,293 83 |
| Other | 5,000 02 | 149,000 00 |
| **Net corporate income** | 1,052,222 66 | 1,069,539 40 |
| Disposition | ............ | ............ |
| Interest on stock | 1,280,103 93 | 1,440,448 18 |
| **Deficit during period** | 227,881 27 | 370,908 78 |
| **Deficit at beginning of period** | 53,965 59 | 281,846 86 |
| **Deficit at end of period** | 281,846 86 | 652,755 64 |

unsettled (an increase of wages was granted to trainmen, effective May 1, 1915, of 2 cents an hour, amounting to about $140 000 per year), with financial and industrial conditions not of the best, and with constantly increasing costs of operation, it will probably be some time before it is possible to reduce fares in Cleveland again, if in fact such a time ever comes.

Directing attention to the expenditures for "Operation",[1] Table

[1] It should be borne in mind that the ordinance recognizes two kinds of operating expenses, viz.: "Maintenance" and "Operation."

TABLE CLI — INCOME ACCOUNT — THE CLEVELAND RAILWAY COMPANY — BASED ON RECEIPTS AND ALLOWANCES

| Year ended | Feb. 28, 1914 | Feb. 28, 1915 |
|---|---|---|
| Interest fund, first day | $537,169 41 | $351,523 74 |
| **Credits, total** | **7 249.367 11** | **7,849,731 82** |
| Operating revenue | 7,213,652 54 | 7,801,490 96 |
| Other income | 35,714 57 | 48,240 86 |
| **Debits, total** | **7,435.012 78** | **7,883,097 71** |
| Allowances, total | 5.376,298 52 | 5,722,524 13 |
| Maintenance, ren. and dep | 1.514,602 04 | 1,600,706 55 |
| Operation | 3,711,954 39 | 3,905,817 58 |
| Other | *a b* 149,742 09 | 216,000 00 |
| Taxes | 450,391 90 | 470,118 13 |
| Interest | 1,581,728 44 | 1,734,412 13 |
| Miscellaneous | *c d* 26,593 92 | *e* Cr. 43,956 68 |
| Decrease in interest fund | 185,645 67 | 33,365 89 |
| Interest fund, last day | 351,523 74 | 318,157 85 |
| OPERATING STATISTICS * | | |
| *Passengers* | | |
| Number of fares | 222 966 762 | 229,770.504 |
| Number of employees' passes | 884.842 | 913,857 |
| Number of dead heads | 2,236,278 | 1,891,748 |
| Number of transfers | 88,559,075 | 91,665,157 |
| **Total number of rides** | **314,646,857** | **324,241,266** |
| *Car miles (revenue)* | | |
| Motor, city | 27,889,307 | 28,445,109 |
| Motor, interurban | 1,288,865 | 1,335,587 |
| Trailer, 60% | 1,328,015 | 2,269,173 |
| Trailer, 100% | 2,213,259 | 3,781.952 |
| Mail, express, etc | 239,229 | 229,615 |
| **Total ordinance** | **30,745,416** | **32.279.484** |
| **Total actual car miles** | **31,630,760** | **33,792,263** |

| | | |
|---|---|---|
| *a* (July). Overdraft in operating allowance | | $259,592 53 |
| Closing out balance in insurance reserve as of Feb. 28, 1913 | $63,048 55 | |
| Closing out balance in accident reserve as of Feb. 28, 1913 | 152,954 33 | |
| | | 216,002 88 |
| | | $43,589 65 |
| *b* (August). Portion of over-expenditures on account of maintenance prior to March 1913 | | $106,152.44 |
| *c* (June). Cost of arbitration in excess of $5,000.00 | | $14,561.80. |
| *d* (February). Adjustment of mileage affecting allowances, June to December, 1913, inclusive Maintenance | $3,791 16 | |
| Operating | 8,240 96 | |
| | | $12,032 12 |
| *e* (July). Stock held by H. E. Andrews, trustee | $38,894 00 | |
| surplus in operating reserve, March 1, 1914 | 919 57 | |
| North Randall Railway Co. adjustments affecting taxes, July, 1912 to December 31, 1913 | 847 77 | |
| Interest July 1912, to December 31, 1913 | 2,436 85 | |
| Operating expenses, July, 1912, to December 31, 1913 | 859 49 | |
| | | $43,956 68 |

* The cars of certain interurban companies operate over the tracks of the Cleveland Railway Co., between the junction points of the city and interurban lines and the Public Square. The Cleveland Railway Co. pays the various interurban companies two cents per car mile, and its car hour proportion of the wages of platform men on the interurban cars. The city company receives 5 cents per passenger carried over its lines, either as a division of a a through rate or as a local fare collected on the cars within the city. Mileage of interurban cars on city tracks is included in the total on which is based the "allowances" for Maintenance, Depreciation, and Renewals and for Operation.

TABLE CLII — COMPARISON OF INTEREST FUND AND TRUE CORPORATE SURPLUS

| | Interest fund | Corporate surplus* | Surplus less than Interest fund by |
|---|---|---|---|
| March 1, 1910 | $500,000 00 | $500,000 00 | ............ |
| February 28, 1913 | 537,169 41 | *53,965 59* | $591,135 00 |
| March 31, 1913 | 571,713 26 | *61,421 84* | 633,135 10 |
| April 30, 1913 | 608,407 09 | *78,366 92* | 686,774 01 |
| May 31, 1913 | 651,875 01 | *92,330 46* | 744,205 47 |
| June 30, 1913 | 612,893 43 | *136,706 50* | 749,599 93 |
| July 31, 1913 | 546,003 96 | *168,006 79* | 714,010 75 |
| August 31, 1913 | 426,690 90 | *180,535 35* | 607,226 25 |
| September 30, 1913 | 402,181 24 | *209,551 67* | 611,732 91 |
| October 31, 1913 | 390,705 80 | *214,602 33* | 605,308 13 |
| November 30, 1913 | 354,886 53 | *283,408 85* | 638,295 38 |
| December 31, 1913 | 363,663 40 | *323,843 94* | 687,507 34 |
| January 31, 1914 | 370,514 76 | *302,702 03* | 673,216 79 |
| February 28, 1914 | 351,523 74 | *281,846 86* | 633,370 60 |
| March 31, 1914 | 355,378 52 | *272,787 05* | 628,165 57 |
| April 30, 1913 | 370,432 28 | *302,586 27* | 673,018 55 |
| May 31, 1914 | 396,705 20 | *318,031 74* | 714,736 94 |
| June 30, 1914 | 337,525 19 | *488,069 10* | 825,594 29 |
| July 31, 1914 | 314,999 59 | *612,069 84* | 927,069 43 |
| August 31, 1914 | 226,011 84 | *709,131 29* | 935,143 13 |
| †September 30, 1914 | 203,232 13 | *798,583 73* | 1,001,815 86 |
| October 31, 1914 | 207,668 97 | *805,566 34* | 1,013,235 31 |
| November 30, 1914 | 225,283 12 | *789,665 26* | 1,014,948 38 |
| December 31, 1914 | 268,677 64 | *757,098 09* | 1,025,775 73 |
| January 31, 1915 | 298,850 64 | *698,604 63* | 997,455 27 |
| February 28, 1915 | 318,157 85 | *652,755 64* | 970,913 49 |

* Assumed to be $500,000 March 1, 1910, for purposes of comparison.
† One cent charge for transfer effective September 1, 1914.
NOTE:— Figures in italics denote deficit.

CLIII shows for the 24 months under observation, the differences between operating allowances and the expenditures which these allowances were designed to cover. Since March 1, 1913, this allowance has, by the permission of the City Council, been 12.1 cents per car mile instead of 11.5 cents and since May 1, 1915, 12.6 cents per car mile.

Table CLIII shows also similar information concerning the allowances and expenditures for "Maintenance, Depreciation and Renewals."

On March 1, 1915, then the operating fund showed an overdraft for two years of $916.03; the Maintenance, Depreciation and Renewal fund an overdraft for the same period of $478 109; and there was a deficit remaining from the total deficit converted into a suspense account at the time of the arbitration, of $145 444.60. The sum of the first two items, $479 025.03, indicates the amount by which the allowances during the past two years have been insufficient to meet the expenses which they were designed to meet, and this total, together with the amount now remaining in the maintenance suspense fund ($145 444.60) indicates the contribution of over $620 000 by the company to continuity and quality of service since March 1, 1910, in

addition to the amount by which its property has depreciated and against which no adequate reserve has been built up. It is of particular interest to note that under the present system no reserves, such as those for Injuries and Damages, Insurance and other provident funds can be built up. It is obvious that this is in violation of well established principles of sound accounting and business prudence.

TABLE CLIII — ALLOWANCES AND EXPENDITURES — THE CLEVELAND RAILWAY CO., MARCH 1913 TO FEBRUARY 1915

| Month | Maintenance, Depreciation and Renewals | | Operation | |
|---|---|---|---|---|
| | Allowance | Expenditures | Allowance | Expenditures |
| 1913 | | | | |
| March | $96,433 88 | $114,811 76 | $291,712 49 | $307,847 21 |
| April | 94,597 60 | 131,431 15 | 286,157 74 | 295,475 60 |
| May | 102,091 44 | 156,190 81 | 308,826 61 | 304,671 20 |
| June | 153,962 52 | 164,279 85 | 310,491 08 | 311,253 70 |
| July | 161,504 58 | 172,269 02 | 325,700 90 | 313,556 72 |
| August | 163,599 54 | 169,150 57 | 329,925 74 | 314,322 79 |
| September | 156,507 61 | 146,981 46 | 315,623 65 | 320,294 52 |
| October | 155,368 56 | 132,288 13 | 313,326 59 | 320,765 29 |
| November | 124,644 75 | 146,505 70 | 301,640 29 | 303,696 83 |
| December | 110,622 72 | 158,997 83 | 334,633 76 | 333,838 52 |
| 1914 | | | | |
| January | 104,743 72 | 87,146 98 | 316,849 75 | 320,007 72 |
| February | 94,316 28 | 68,394 18 | 285,306 75 | 283,267 30 |
| March | 104,061 32 | 94,997 61 | 314,785 49 | 324,493 63 |
| April | 102,874 60 | 155,485 22 | 311,195 67 | 309,287 40 |
| May | 110,647 92 | 167,952 20 | 334,709 96 | 324,957 34 |
| June | 168,726 30 | 290,630 31 | 340,264 70 | 335,031 92 |
| July | 178,349 10 | 251,783 78 | 359,670 69 | 349,449 51 |
| August | 181,313 88 | 209,142 65 | 365,649 66 | 350,791 67 |
| September | 163,119 36 | 230,552 12 | 328,957 38 | 334,029 69 |
| October | 161,481 42 | 169,125 31 | 325,654 20 | 335,272 49 |
| November | 125,985 85 | 111,620 06 | 304,885 76 | 326,964 62 |
| December | 106,778 12 | 91,607 21 | 323,003 81 | 357,684 60 |
| 1915 | | | | |
| January | 103,208 32 | 92,733 12 | 312,205 17 | 300,359 91 |
| February | 94,160 36 | 92,599 17 | 284,835 09 | 265,854 47 |
| *Expenditures:* Deduct a/c North Randall Railway | ............ | Cr. 9,467 45 | ............ | Cr. 18,077 75 |
| TOTAL | $3,119,099 75 | $3,597,208 75 | $7,626,012 93 | $7,625,096 90 |
| Deficiency of allowance | ............ | $478,109 00 | ............ | $916 03 |

With respect to depreciation, it appears that the ordinance contemplates that the maintenance of all physical property, as well as its depreciation, shall be met from an allowance of approximately 5 cents per ordinance car mile.

During 1914, the allowance per actual car mile — that is, per car mile in which the mileage of trailer cars is given full weight — was 4.75 cents. Depreciation alone on a well-operated plant will not be

less than 3.75 per cent of the cost new of the physical property. The 1909 valuation of the property operated by The Cleveland Railway Co. was $27 596 366 and since that time there has been invested in additional property, $6 747 555, making the cost new of the present plant, $34 343 921; 3.75 per cent of this amount is $1 287 900. This is 3.8 cents per actual car mile or 4.0 cents per ordinance car mile for the year ended December 31, 1914. This leaves of the allowance of 4.75 cents but 0.95 cents per car mile for maintenance of all physical property. The average expenditure in 1912 of nearly 1,000 electric railways in the United States for maintenance (not including depreciation) was 5.75 cents per car mile. While the allowance under the Cleveland ordinance might cover either depreciation or maintenance, it is obvious without a more extended analysis, that any company attempting to meet both maintenance and depreciation charges out of this allowance of 4.75 cents per car mile is attempting the impossible. It was to have been expected that the Cleveland Company would necessarily over-expend this allowance for maintenance, depreciation and renewals. This over-expenditure has already amounted to $623 000, and it is certain that the item "Deferred Maintenance" will be one of increasing importance. Attention should again be called to the $700 000 worth of property retired some three years ago and which still appears in the balance sheet to the amount of $553 002, as "Road and Equipment Suspense." The necessity of meeting the cost of property retired is inevitable whether the loss is insured by a proper reserve or amortized after the property is retired. The difference is that car riders in the future will pay for losses incurred for the benefit of car riders in the past.

In the matter of taxes, The Cleveland Railway Co. is in a unique position. It is to the evident interest of the city of Cleveland to keep expenditures of every kind at a minimum and there is pending at the present time an action brought by the Company seeking to have the assessment of The Cleveland Railway Co. reduced for the past two years. This action was brought following the adoption by the City Council of a resolution requesting the City Street Railroad Commissioner to direct the company to ask for a rehearing before the Tax Commission on the question of valuation and to refuse to pay taxes on an amount in excess of $19 000 000. In the meantime charges are made monthly on the basis of the assessment now under dispute and the amounts thus accumulated are included in the interest fund. In case the City is successful in its fight to have the assessment lowered, there will be, after the payment of taxes for the last two years, a balance in this tax reserve fund which will be credited to the interest fund. It is impossible to state at this time how much this will amount to but it will probably, even in the event of a particularly favorable decision, not be large enough to materially change the status of the interest fund.

The Cleveland Railway Co. is not required to pay any car license fee, and as has been indicated, the company is freed from certain obligations in connection with paving.

With regard to the charges made for interest, as has been previously pointed out, interest on funded debt and bills payable is charged to the interest fund as payments are made. When securities are sold at a premium the amount of this premium is credited directly to the interest fund and when securities are sold below par, the discount is amortized through monthly charges to the interest fund. Interest is allowed on outstanding stock at 6 per cent per annum, but since the outstanding stock is materially less in amount than the actual capital investment prior to the adoption of the present working agreement, the fixed rate of return guaranteed by the City is more nearly 4 per cent per annum on the cost of the property than 6 per cent, as would appear from a casual reading of the ordinance.

In conclusion, it will be well to examine the balance sheet of The Cleveland Railway Co. as of December 31, 1914.

| Assets | | Liabilities | |
|---|---|---|---|
| Property account, including Judge Tayler's valuation of old franchises, etc | $29,042,904 43 | Capital stock | $25,221,200 00 |
| Road and equipment suspense | 553,002 97 | Scrip | 27,954 65 |
| Cash | 112,055 31 | Bonds | 5,495,000 00 |
| Interest fund | 1,074,277 21 | Bills payable | 95,000 00 |
| Sinking fund | 20,964 32 | Accounts payable | 575,502 13 |
| Bond discount | 129,035 68 | Accrued accounts | 838,653 90 |
| Investments | 71,500 00 | Ticket float | 151,274 38 |
| Bills receivable | 3,125 00 | Old companies | 317,602 20 |
| Repair accounts | 53,055 71 | | |
| Accounts receivable | 288,898 56 | | |
| Stores | 461,344 83 | | |
| Maintenance reserve | 490,686 80 | | |
| Maintenance suspense | 157,444 60 | | |
| Operating reserve | 32,569 48 | | |
| Income | 231,322 36 | | |
| | $32,722,187 26 | | $32,722,187 26 |

The liability designated as "old companies" is the remainder of a surplus earned during the operation of the Railway by receivers Scott and Bicknell. All obligations of the receivers and of the Municipal Traction Co. and the Forest City Street Railway Co., such as liabilities for damages on account of personal injuries, are paid out of this surplus.

The interest fund on December 31, 1914, was $268 677.64; the amount appearing in the balance sheet under this head is $1 074 277.21. The difference or $805 599.57, represents funds reserved for the payment of taxes when the pending suits are decided, and accruals to December 31, 1914, of bond interest and interest on stock.

Included as assets are overdrafts on reserves, suspense accounts and income, totalling $1 465 026.21 and consisting of the following items:

| | |
|---|---|
| Income | $231,322 36 |
| Road and equipment suspense | 553,002 97 |
| Maintenance reserve | 490,686 80 |
| Maintenance suspense | 157,444 60 |
| Operating reserve | 32,569 48 |
| Total | $1,465,026 21 |

In the ordinary corporate balance sheet, this amount would be listed as "Deficit."

The first of the items above, "Income," represents the amount by which the interest fund was less on December 31, 1914, than it was on March 1, 1910, and the total of the amount here shown and the amount included in the balance sheet as "Interest Fund" together equal $500,000, the initial amount of that fund, in accordance with terms of ordinance.

The second item "Road and Equipment Suspense" represents a portion of the cost of certain equipment which was retired from service prior to 1913. The original charge here was about $700,000, and this has been reduced through credits from salvage and by the credit of $120,000 from interest fund, at the rate of $12,000 per month to the present figure.

The third and fifth amounts "Maintenance Reserve" and "Operating Reserve" indicate the extent to which the ordinance "allowances" for Maintenance, Depreciation and Renewals and for Operation had been over-expended on December 31, 1914.

The fourth item, "Maintenance Suspense" represents what still remains unliquidated of an overdraft on the maintenance "allowance" which had reached nearly $220,000 on March 1, 1913. During the last year, this account has been reduced at the rate of $6,000 per month.

The balance sheet indicates that in addition to the depreciation of the physical plant of the Cleveland company for which no reserve has been maintained, and which has amounted to no inconsiderable figure during the past five years, there has been an operating loss of $1,465,026.21. Had interest been paid during this period on the $10,000,000 of stock which was surrendered in 1908, this operating deficit would at the present time have amounted to approximately $1,750,000.

It is of interest now to study briefly the expenditures of the Cleveland company during the past year, with a view of determining, *first*, the relation between the average length of ride and the length of ride which at the present rate of fare would permit the company to earn a reasonable return, and *second,* what it would cost the company to furnish service conforming to the standards set by the Railroad Commission of Wisconsin and those proposed by the Board of Supervising Engineers, Chicago Traction.

It will be necessary first to determine the amount of those costs which vary with the length of ride and of those independent of the

length of ride. There have been discussed in Chapters VII and XIV, at considerable length, the problems connected with the separation of costs into those which have a functional relation to the car hour, car mile, passenger, and other units of service, and the further separation into those costs varying with the distance the passenger is transported and those costs practically independent of the length of ride. In view of the extended description of methods in previous chapters, it is unnecessary here to go into the details of such apportionments or to discuss at length the factors to be considered in primary and secondary separations.

From the detailed report of operating expenses for the calendar year 1914 and the average investment in the property for that year, certain conclusions may be drawn as to the cost of service. The actual operating expenses, including taxes, amounted to $6,346,671, and for purposes of computation, the depreciation is fixed at 3.75 per cent. of the average investment in physical property for the year of $33,646,821. The return on investment is taken as the actual amount of interest disbursed, although this amounts to somewhat less than 6 per cent. on the depreciated value of the property. The income account for the year 1914, with operating expenses grouped in accordance with the units with which the individual items are estimated to vary, is set forth in Table CLIV.

TABLE CLIV — INCOME ACCOUNT AND UNIT COSTS CALENDAR YEAR, 1914.

| | Amount | Number of units | Cost per unit |
|---|---|---|---|
| Operating revenues (Total) | $7,692,343 | ............ | ............ |
| Operating expenses (Total) | *$9,310,687 | ............ | ............ |
| (*a*) Costs varying with car hour | 2,021,019 | 3,235,400 | 62.5c |
| (*b*) Costs varying with car mile | 1,163,744 | 33,745,179 | 3.10c |
| (*c*) Costs varying with miles of single track | 762,077 | 344.75 | $2,207 |
| (*d*) Costs varying with number of passengers carried | 754,897 | 230,149,207 | .328c |
| (*e*) Costs of electrical energy, car mile. | 825,465 | 33,745,179 | 2.44c |
| (*f*) Administrative and overhead expense burden | 819,469 | % (a) to (e) | 14.8% |
| (*g*) Replacement insurance† | 1,261,756 | ............ | ............ |
| (*h*) Return upon investment | 1,702,260 | ............ | ............ |
| Deficit | ‡$1,618,344 | ............ | ............ |

* Cost per revenue passenger 4.03c; allowing 8% return, 4.62c.
† Depreciation 3.75% on average investment $33,646,821.
‡ If return upon investment is computed at 8 per cent on cost of physical property, plus agreed value of franchises, plus amount of interest defaulted by Municipal Traction Company, lessor, the deficit becomes $2,989,761.

A calculation of the cost per revenue passenger in previous years was made by Mr. C. Nesbitt Duffy.[1] A part of his result is shown in Table CLV.

[1] 1913 Proceedings, American Electric Railway Association, page 121.

TABLE CLV — COST IN CENTS OF CARRYING A REVENUE PASSENGER BY THE CLEVELAND RAILWAY CO.

| ITEM | Year ending Feb. 28, 1911 | Year ending Feb. 29, 1912 | Year ending Feb. 28, 1913 | Average for three years |
|---|---|---|---|---|
| | (*Cents*) | (*Cents*) | (*Cents*) | (*Cents*) |
| (*a*) Cost as per company's books | 3.63 | 3.50 | 3.29 | 3.47 |
| (*b*) Cost as per company's books adjusted to conform with the arbitration decision of June 19, 1913 | 3.58 | 3.45 | 3.27 | 3.43 |
| (*c*) Cost after providing for insurance reserve, accident reserve, ordinary maintenance and depreciation, 6 per cent return on capital value | 3.87 | 3.79 | 3.64 | 3.76 |
| (*d*) Cost after providing for insurance reserve, accident reserve, ordinary maintenance and depreciation, 8 per cent return on capital value | 4.15 | 4.06 | 3.89 | 4.03 |
| (*e*) Cost after providing for insurance reserve, accident reserve, ordinary maintenance and depreciation, 6 per cent return on capital value, amortization for 50 per cent loss in capital value, figured on a 4 per cent sinking fund basis | 4.15 | 4.05 | 3.88 | 4.02 |
| (*f*) Cost after providing for insurance reserve, accident reserve, ordinary maintenance and depreciation, 8 per cent return on capital value, amortization for 50 per cent loss in capital value, figured on a 4 per cent sinking fund basis | 4.43 | 4.32 | 4.13 | 4.29 |

These costs do not include any provision for contingencies—extraordinary (casualties).

The costs as detailed in Table CLIV may be grouped under two classifications: (*a*) the "traffic" group, containing expenditures varying with the extent of traffic, such as the car hour and car mile costs, and (*b*) the "fixed" group, containing expenditures independent of the amount of traffic, such as the mile of track costs, a portion of the replacement insurance, and the interest charge which is fixed under the ordinance. It is also necessary to determine what part of the traffic expenses varies with use by the passengers of facilities furnished, that is, with the passenger mile, and what part is in the nature of a demand cost and as such should properly be borne alike by all passengers. The load factor, that is, the relation between the service utilized and that furnished, or the relation between passenger miles and seat miles (with allowance for preferential standing), gives the basis for the determination of the "use" and "demand" portions of the "traffic" group of expenses. These computations may be summarized as follows:

Expenses varying with the passenger miles for the year 1914, amount to $3,012,831. There were 323,716,193 rides and if the average length of ride in miles be indicated by **M**, the total passenger miles may be stated as 323,716,193 **M**.

This gives a cost per passenger mile of $\frac{.93}{\mathbf{M}}$ cents.

Expenses varying with the number of passengers amount to $6,297,856, or 1.94 cents per passenger.

There are at present three rates of fare in effect in Cleveland,

(*a*) 3-cents — limited area — no transfer.

(*b*) 4-cents — limited area — with transfer.

(*c*) 5-cents — to certain outlying districts.

Considering all rides on the lines of The Cleveland Railway Co. whether revenue passenger or transfer, the average fare prior to September 1, 1914, when the one cent charge for transfer went into effect, was 2.25 cents. Representing as above the average length of ride of all passengers as **M** miles,

the cost in cents per passenger was $1.94 + \frac{.93}{\mathbf{M}}$

Hence a fare of 2.25 cents paid for a ride of but one-third the average actual length of haul. With the charge of one cent for transfer, the average fare became 2.54 cents per ride and the fare paid for a ride two-thirds the actual average length of haul.

Within the 3-cent area, the average length of ride as determined from the traffic survey was 2.61 miles, and the cost per passenger mile was 0.356 cents. With 40 per cent. of the riders using a transfer the average fare per ride was 2.43 cents which paid for a ride of 1.38 miles as compared with the average ride of 2.61 miles.

Table CLVII — Cost of Furnishing Additional Service Required Under the Wisconsin and Proposed Chicago Standards

| Period | Cost per car hour per year | Cost of additional service | | | |
|---|---|---|---|---|---|
| | | Wisconsin standard | | Chicago standard | |
| | | Car hours | Amount | Car hours | Amount |
| 12–5 A. M. | $647 | ........ | ........ | ........ | ........ |
| 5–6 A. M. | 686 | ........ | ........ | ........ | ........ |
| 6–7 A. M. | 738 | 23 | $16,974 | 16 | $11,808 |
| 7–8 A. M. | 772 | 25 | 19,300 | 2 | 1,542 |
| 8–9 A. M. | 720 | 69 | 49,680 | 7 | 5,040 |
| 9–4 P. M. | 652 | 189 | 123,228 | 25 | 16,300 |
| 4–5 P. M. | 815 | 80 | 65,200 | 4 | 3,260 |
| 5–6 P. M. | 1,018 | 51 | 51,918 | 1 | 1,018 |
| 6–7 P. M. | 742 | 145 | 107,590 | 5 | 3,710 |
| 7–8 P. M. | 664 | 29 | 19,256 | 5 | 3,320 |
| 8–12 P. M. | 646 | 38 | 24,548 | 10 | 6,460 |
| Totals | ........ | ........ | $477,694 | ........ | $52,458 |

Referring to the second problem or the cost of furnishing service, it will be noted that the cost of transportation facilities varies throughout the day. The determination of expenditures necessary to comply with service standards involves therefore the preliminary computation of costs at different hours of the day.[1] These results are summarized in Tables CLVI and CLVII.

[1] The method of cost analysis here applied is described in Chapter XVI.

In Table CLVII there is shown the cost of complying with the service standards as prescribed by the Wisconsin Railroad Commission and as proposed by the Board of Supervising Engineers, Chicago Traction. In this table the cost per car hour per year is shown, together with the number of additional car hours required under the two service standards mentioned above. As has been pointed out previously, it might be possible to meet the requirements for additional service to a limited extent, by the reconstruction of schedules in which use would be made of certain car hours now in service, but which would not be required by either the Chicago or the Wisconsin standards. The practical difficulties of schedule making are such, however, that it would not be possible to save any material part of the expenditure indicated in Table CLVII by such shifts in service.

## Conclusions.

From the study of costs in Cleveland and the survey of operating and traffic conditions peculiar to Cleveland, the following conclusions may be drawn:

(1) While the regulating Ordinance contemplates fixing the rates of fare to conform with costs, the actual costs of service have considerably exceeded those recognized by the Ordinance due to the inadequacy of allowances for operation and maintenance, the failure to provide reserves for injuries and damages and insurance, and the failure to make due provision for depreciation.

(2) The actual value of property used for the transportation business exceeded that recognized by the Ordinance, due to the arbitrary reduction of the cost new of physical property to approximately 70 per cent of such value. To reproduce identical facilities for rendering transportation service would require an investment in excess of that assumed in the Ordinance.

(3) The rate of return provided in the Ordinance, or 6 per cent., is not comparable with the rate of return necessary to attract money into the urban transportation business under conditions where, unlike Cleveland, such return is not guaranteed.

(4) The actual costs of operation per passenger are considerably less than those of urban transportation systems in other American cities, due to the coöperation of the public and the City of Cleveland. The skip-stop, headway as high as 5 minutes on heavy lines, the use of trailers and short routing, the loading and collection practice and the regulation of vehicular traffic are evidences of this coöperation. These innovations have had a substantial effect on costs.

(5) The scheme of Ordinance regulation as provided in Cleveland retards the extensions of existing lines and will in time no doubt materially affect the distribution of population.

(6) The service rendered is found to result in a degree of crowding and a proportion of standing passengers which discloses a standard of service below that prescribed as adequate in other American cities.

TABLE CLVI — COST OF SERVICE BY PERIODS AND COST OF ADDITIONAL SERVICE DURING ANY PERIOD, OVER THAT PERIOD SHOWING NEXT LESS SERVICE. THE CLEVELAND RAILWAY CO.

| PERIOD | Car hours per hour | Car miles per hour | Cost per hour per year * | Increments | | | | Increment costs | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost per car hour per year | Car hours per hour | Car miles per hour | Cost per hour per year | Per car hour | Per car mile |
| 12– 5 A. M. | 88 | 992 | $59,971 | $647 | ........ | ........ | ........ | ........ | ........ |
| 8–12 P. M. | 270 | 3,048 | 174,472 | 646 | 182 | 2,056 | $114,501 | $629 | $55 |
| 9 A. M.–4 P. M. | 372 | 3,966 | 242,453 | 652 | 102 | 918 | 67,981 | 666 | 74 |
| 7– 8 P. M. | 376 | 4,250 | 249,713 | 664 | 4 | 284 | 7,260 | 1,815 | 26 |
| 5– 6 A. M. | 617 | 6,600 | 423,016 | 686 | 241 | 2,350 | 173,303 | 719 | 74 |
| 8– 9 A. M. | 832 | 8,320 | 598,824 | 720 | 215 | 1,720 | 175,808 | 818 | 102 |
| 6– 7 A. M. | 860 | 8,600 | 629,318 | 732 | 28 | 280 | 30,494 | 1,089 | 109 |
| 6– 7 P. M. | 914 | 9,140 | 677,839 | 742 | 54 | 540 | 48,521 | 898 | 90 |
| 7– 8 A. M. | 953 | 9,530 | 736,223 | 772 | 39 | 390 | 58,384 | 1,497 | 150 |
| 4– 5 P. M. | 1,041 | 10,410 | 848,610 | 815 | 88 | 880 | 112,387 | 1,277 | 128 |
| 5– 6 P. M. | 1,184 | 11,840 | 1,205,470 | 1,018 | 143 | 1,430 | 356,860 | 2,496 | 250 |

* These costs do not include any allowance for replacement insurance.

(7) While the average rate of fare per revenue passenger is now generally 3-cents, with 1-cent for transfers in conformity with ordinance costs, the increase of actual costs of operation reflected in the deficiencies of operating allowances leads to the conclusion that the car riding public of Cleveland may expect to face the alternative of higher fares or poorer service.

(8) Taking into consideration further the property abandoned, which is only now partially written off, if would appear that the present generation of car riders is receiving transportation costing in excess of fares paid, leaving future generations to pay for equipment worn out from past service. In effect, such a process of paying for the depreciation of the property results in converting physical property values into service rendered and if continued would affect the security of the property which the Ordinance is pledged to safeguard.

## CHAPTER XXVII

### THE MILWAUKEE EXPERIMENT; EVENTS PRECEDING DECISIONS OF THE RAILROAD COMMISSION OF WISCONSIN, AUGUST 23, 1912

Agitation for 4-cent Fare in 1896,—— Determination by the United States Circuit Court of Reasonableness of Ordinance of June 8, 1896 Regulating Rates,—— Early Adjudications of Value and Cost,—— The 1900 Franchise,—— Railroad Commission Law of 1905,—— Agitation for 3-cent Fare in 1906,—— Audits and Appraisals,—— Testimony on Cost.

In the five preceding chapters, there has been discussed in some detail the working of regulation by contract. In the present chapter and the two that follow, there will be considered the situation in Milwaukee where the regulation of the traction company has been continuous since the establishment of the Railroad Commission of Wisconsin. Under the theory of continuous regulation, changes have been made from time to time in rates of fare and standards of service in an attempt to adjust the service and rates to conditions as they developed along lines which were not foreseen.

The story of the regulation of The Milwaukee Electric Railway and Light Co. may be found in the decisions of the Federal and State courts, in the opinions and orders of the Railroad Commission of Wisconsin since it assumed jurisdiction, and in various ordinances and orders of the city government of Milwaukee. The various decisions and orders, as here treated, cover the period from the inception of the consolidated or present company, February 1, 1896, up to the present time, November, 1915, the greater number occurring since the establishment of the Railroad Commission of Wisconsin. The regulatory actions which have to do with cost of service will be given particular attention and an effort will be made to summarize some of the studies of costs presented to the regulating authorities and the various findings of these authorities upon the cost of service.

On June 8, 1896, the city of Milwaukee passed an ordinance which required a traction company to sell tickets, each good for one fare including one transfer, in strips of 6 tickets for 25 cents or 25 tickets for $1.00. The enforcement of the ordinance was permanently enjoined by the United States Circuit Court on May 31, 1898.[1] This ordinance was the result of severe agitation during the period of depression in and preceding 1896. Prior to August 1, 1894, the predecessor companies operating within limited areas had issued commutation tickets at the rate of 25 for $1.00 or 12 for 50 cents. The discontinuance of these tickets was due to increased tax assessments and the fact that the consolidated company was then defaulting on its bond interest. The consolidation, moreover, provided universal transfers, an increased area served and more satisfactory service. Immediately prior to the introduction of the ordinance, a strike had

[1] T. M. E. R. & L. Co. vs. City of Milwaukee, 1897, 87 Fed. Rep. 577.

occurred upon the Company's properties. Ordinances introduced at about the same time provided for the granting of franchises to competing traction lines, the forfeiture of the franchises of the existing company, the annulment of its charter, the regulation of the running of cars, the condemnation of its property, and investigations as to the possibility of municipal ownership.

As stated above, the enforcement of the low fare ordinance was permanently enjoined by the United States Circuit Court on May 31, 1898, the case decided being one of the first involving the cost of electric traction service. The Milwaukee Electric Railway and Light Co. had, immediately prior to the passage of the ordinance, succeeded to the property of Milwaukee Street Railway Co. upon foreclosure, while the Milwaukee Street Railway Co. had during the six preceding years succeeded to the property of five separate traction systems. All the contracts of acquisition, showing the actual considerations paid in the purchase of the predecessor companies and all licenses, franchises, charters and deeds were placed in evidence before the United States Circuit Court.[1] The books were audited upon behalf of the City and appraisals of the physical property were undertaken both for the city and for the company. A number of pioneers in the electric traction industry gave testimony as to normal costs of operation and the factors to be considered in determining costs.

The evidence of the various elements of value for rate making purposes, presented as of January 1, 1897, brought out closely the differences between investment and reproduction value following electrification and consolidation and may be summarized as follows:

| | |
|---|---|
| Securities of constituent companies taken at par........ | $11 313 830 |
| Securities of constituent companies taken at market prices .............................................. | 9 721 596 |
| Cash cost of constituent companies, taken as equivalent to bonds at market prices and no value for stock. | 8 885 644 |
| Cost of reproduction, estimate by William J. Clark...... | 5 153 288 |
| Cost of duplicate plant, estimate by William J. Clark based upon city engineer's specifications............. | 7 084 680 |
| Cost of duplicate plant, estimate based upon average cost of Massachusetts roads......................... | 6 537 822 |
| Cost of duplicate plant, estimate based upon average cost of ten leading roads of Massachusetts................ | 7 563 772 |
| Cost of reproduction, estimate by city's experts........ | 2 782 158 |
| Actual amount expended, *after* acquisition of constituent companies for *additional* electrical equipment......... | 3 124 421 |

The rapid changes in the development of electric traction at this period were well brought out by the testimony of Winthrop Coffin, a prominent engineer. Mr. Coffin discussed in detail the pioneering ventures of electric railway operation during the early eighties, commenting on the development work of Charles J. Vanderpool, Leo Daft, The Bentley Knight Co., Thomson-Houston Co.,

[1] A diagram of predecessor companies and a briefed outline of these purchases has been published in City of Milwaukee vs. T. M. E. R. & L. Co., 1912, 10 W. R. C. R. 1,12.

Frank J. Sprague and others. Mr. Coffin pointed out the optimism of early operators as to earnings, based unwisely as it later developed, upon the stimulus given to riding by the early electrification of a few lines in competition with others still operated by horse power; the rapid changes in the art and the consequent necessity of abandoning much equipment but partly worn and the making of replacements entailing large additional investment. He commented also in some detail upon the development in the railway motor, the increase in the capacity of generators, the change in type of tracks necessitated by heavy wheel loads, the larger, heavier and more comfortable cars, and other technical changes particularly in the overhead and distribution systems.

Other evidence presented also brought out the large depreciation in value of electrical equipment. William J. Clark pointed out that the cash investment in actual tangible property in earlier years was much in excess of the cost of reproducing this property as found by him at this time and testified in part as follows:

Probably on no large electrical street railway system in the United States is there the necessity to charge off to depreciation so large a percentage of its original cost as at Milwaukee. The system having been constructed at an early period of electric railway development, when everything necessary to construction and equipment was far higher in price than at present, the Company has naturally to meet a great shrinkage in values from decline in cost prices alone, while depreciation arising from usage has proven to be far greater than was estimated upon even as recently as two years ago.

From the above two sources, neither of which could be estimated, appreciated or anticipated, it is safe to say that there has been an average shrinkage from the original costs on all of the Company's physical property, outside of real estate and buildings, of more than 50 per cent.

On the question of value, the Circuit Court found the investment to be $8 885 644.17 and the value for rate making purposes at least $7 000 000. The following extracts from the opinion of Judge Seaman are of particular interest:[1]

* * * I am satisfied that the property of complainant represents a value, based solely upon the cost of reproduction, exceeding $5 000 000. And I am further satisfied that this amount is not the true measure of the value of the investment in the enterprise. It leaves out of consideration any allowance for necessary and reasonable investment in purchase of the old lines and equipments, which were indispensable to the contemplated improvement, but of which a large part was of such nature that it does not count in the final inventory. No allowance enters in for the large investment arising out of the then comparatively new state of the art of electric railways for a large system, having reference to electrical equipment, weight of rails, character of cars, and the like, of which striking instance appears in the fact that the electric motor which then cost about $2 500 can now be obtained for $800; so that work of this class was in the experimental stage in many respects, and the expenditures by the pioneer

[1] 87 Fed. Rep. 577.

in the undertaking may not fairly be gauged by the present cost of reproduction. Of the $5 000 000 and over paid for the acquisition of the old lines, it would be difficult, if not impossible, from the testimony, to arrive at any fair approximation of the share or amount of tangible property which enters into the valuation in this inventory. It does appear that the roadways required reconstruction with new rails and paving, and that the amount stated was actually paid by the investors, making their investment nearly $9 000 000. How much of this may be defined or apportioned as the amount which was both "really and necessarily invested in the enterprise" (vide Road Co. vs. Sandford, supra), I have not attempted to ascertain, except to this extent: that I am clearly of the opinion that at least $2 000 000 of those preliminary expenditures are entitled to equitable consideration, as so invested, beyond the reproduction value, if the valuation of the investemnt is not otherwise found sufficient for all the purposes of this case; but no opinion is expressed in reference to the remaining $1 885 644 * * *

Upon the question of depreciation and its consideration in determining the cost of service, some testimony was developed, which is of interest in view of the lack of experience as to the ultimate life of physical property. E. E. Higgins pointed out that "no one has been able to tell, up to within the last year or two — and even yet, no one is able to tell exactly what the future of electric railroading is going to be. The matters of depreciation and matters of other branches of operating expense — the contingencies — have never been determined, and the case is far different, purely in the matter of physical operation, from the conditions governing in steam railroading." He submitted data described as "theoretical and not actual; but intended to be a close approximation of my idea of the proportions."[1] The lives assumed were roadbed 10 years, overhead construction 15 years, car bodies 15 years, motor trucks 10 years, steam plant 15 years. electric station plant 25 years, buildings 50 years. John I. Beggs estimated, "the utmost life that can be expected from the best roadbed that can be laid today would be, at the outside, ten to twelve years," and "the average life of the double equipment taken as a whole will not exceed 12 years; the life of the motor being somewhat less than that, and that of the car we hope may exceed it possibly several years." The rule was also cited to allow $1 000 for each mile of track and $1 000 for each car operated, as the depreciation for one year.

The court recognized the necessity of depreciation as a part of the cost of operation but made no estimates of the extent of depreciation, stating:

It is manifest that this element must be taken into account before it can be determined that earnings derived from a plant are excessive; and in the same line there is much force in the argument of counsel that consideration should also be given to the factor of depreciation by amortization of franchises, as all the franchises in question terminate in the year 1924. The latter, if allowed would be a matter of simple computation, but a just measure of physical depreciation seems to some extent, although only partially, involved in provisions for

[1] *Street Railway Journal* Vol. 1, No. 5, May 1895. Higgins — Function of a Reserve Fund in Street Railway Operation.

maintenance; and, whilst the testimony is very full and instructive upon this subject, it does not save from serious difficulties in the way of stating a definite ratio or sum for such allowance. I am, however, clearly of the opinion that neither of these elements is essential to the determination of this case, upon any aspect presented by the testimony, and leave it so far open that it may serve as an important factor of safety in either view.

The analysis of operating expenses presented to the court measured costs in terms of the car day, the car mile and the mile of track. Comparisons were made between the operating expense of 14.8 cents per car mile in Milwaukee and 19.7 cents per car mile in Massachusetts. Necessary earnings per car mile in Milwaukee were placed by various witnesses at 25 cents per car mile and at $30 and $25 per car day. Such unit comparisons were not referred to or passed upon by the court. From the analysis of the accountants' findings[1] however, and the investment determined, the court concluded:

I am of opinion that the testimony is not only convincing in support of the material allegations of the bill but is uncontradicted and conclusive that the improved service received by the public, with the universal system of transfers, is well worth the five-cent fare charged therefor; that the company has not received earnings in excess of an equitable allowance to the investors for the means necessarily invested in furnishing such service; that enforcement of the ordinance would deprive complainants of property rights by preventing reasonable compensation for service; and that, therefore, the ordinance clearly violates the Constitution of the United States and is invalid.

To those interested in the development of regulation and the determination of normal costs as an aid to the fixing of rates, the case discussed above will prove of great interest. Many details appear in the testimony and decision which it has been impossible to reproduce here.

The decision of 1898 did not permanently settle the controversy as to rates of fare. The financial requirements of the company necessitated the extension of franchises beyond 1924 if a satisfactory bond issue for future extensions was to be made. An ordinance extending existing franchises to December 31, 1934, was passed by the Milwaukee Common Council on January 2, 1900. From a taxpayer's suit[2] immediately following the passage of the franchise, brought with the purpose of enjoining the company from accepting the ordinance, it appears that in 1898 the company —

* * * offered to pay the city annually on the first of January of each year, large sums of money, beginning with $50,000 and increasing the sum each year by $10 000 until it reached $100 000 annually, in case said city would grant the right to charge five-cent fares until the year 1935. These offers were, however, rejected by the city, and the present ordinances adopted, by the terms of which

[1] For an analysis of evidence on earnings during early years of operation, and testimony of comparative costs of operation, see city of Milwaukee, vs. T. M. E. R. & L. Co., 10 W. R. C. R. 123 to 131 inclusive.

[2] Linden Land Co. vs. T. M. E. R. & L. Co. 107 Wis. 1900, 493, 505.

no moneys are to be paid to the city, but the company is required to sell 25 tickets for $1.00, good for travel during certain morning and evening hours until January 1, 1905, and after that time good during all hours of the day.

In addition to specifying the rates of fare, the ordinance of January 2, 1900, provided a uniform and concurrent date for the termination of all franchises; obligated the Railway Company to repair paving in the track zone with the same material as the city had used to pave or repave previous to such repairs; provided that with the extension of the city limits in the future, tracks were not to be extended unless there was reasonable necessity therefor for the convenience of the traveling public; provided that each passenger was entitled upon demand made at the time of payment of fare to one transfer to any connecting or crosstown line at the established points of transfer; provided that in consideration of the rights and privileges granted, the company should furnish the city electric power necessary and sufficient to swing and operate all drawbridges then and thereafter maintained and make all necessary connections for such service; provided for the continuance of ordinances relating to the removal of snow and ice, the joint use of tracks by other companies, the occupancy and use of streets, bridges and public places, the repairing, replacing, strengthening and maintaining of the same, and the gauge, grade and elevation of tracks, etc., and provided that the company should at all times carry and transport all members of the police, fire and health departments of the city free of charge, the rights and privileges granted being considered a prepayment by the city of all fares of all such members and officers of these departments.

The Wisconsin legislature in 1905, after a spectacular campaign by Robert M. LaFollette, passed the Railroad Commission Law.[1] It gave the Commission broad powers with respect to the charges and service of common carriers. During 1906, much publicity was given in the Milwaukee papers to the three-cent fare propaganda of Tom L. Johnson in Cleveland, and on November 28, 1906, a complaint was filed with the Railroad Commission of Wisconsin by the City of Milwaukee, alleging that the rates stated in the 1900 franchise "were exorbitant and excessive and that a fair rate of compensation for the service performed by the company would be a charge of not to exceed two cents for one continuous ride, with the privilege of one transfer." At this time the question arose as to the jurisdiction of the Railroad Commission over street railways, and the Wisconsin legislature in 1907 specifically provided such jurisdiction.[2] To safeguard against any claim for amortization due to expiring franchises as a part of the cost of service, the city attorney of Milwaukee appeared in behalf of an indeterminate franchise law[3] which was

[1] Chapter 362, laws of 1905.
[2] Chapter 582, laws of 1907.
[3] Chapter 578, laws of 1907.

passed, providing that street railways could upon surrender of existing grants at any time prior to their expiration secure indeterminate grants terminable by purchase by the city. A second or amended complaint was then filed with the Railroad Commission by the City of Milwaukee on May 13, 1908, alleging that the fares fixed by the 1900 franchise were "unreasonable and unjust" and that a "reasonable return upon the value of the property actually and necessarily used, the expenses of management and operation and a reasonable allowance for depreciation can be made for a much smaller fare." While this complaint did not specify or suggest a revised rate of fare for the Commission's guidance, the case was known as the "three-cent fare" case.

Early in 1907, the city employed Edward E. Gore, C. P. A. of Barrow, Wade, Guthrie and Company, to audit and report upon the books of account for the period January 1, 1897, being the date of Judge Seaman's decision, to December 31, 1906. Subsequently, the company employed Charles J. Marr, C. P. A., of Dickinson, Wilmot and Sterrett, to review the report of Barrow, Wade, Guthrie and Company. Both the city's and the company's accountants subsequently agreed upon net additions to physical property amounting to $5 432 868, for the ten-year period, including items improperly credited to depreciation reserve, excluding credits for scrap sold, bond discounts and the greater portion of a stock transaction involved in the purchase of real estate. The city accountants found a revised book value for the railway property on January 1, 1897, of $9 020 147, as compared with the value found by Judge Seaman in the Circuit Court, of $8 885 644.

In 1907, the Wisconsin State Board of Assessment, acting jointly on behalf of the Wisconsin Tax Commission and the Wisconsin Railroad Commission, undertook an appraisal of the physical property of the company. There was some misunderstanding as to the use which such an appraisal would serve. The company's position, as testified to by the Engineer of the State Board of Assessment was:

> At the first of these conferences, Mr. Beggs (the president of the company) stated frankly that he regarded the present valuation as being directed primarily to taxation purposes and he and his representatives held consistently to this contention. Because of this attitude it was necessary to remind them repeatedly that these conferences were for the purpose of receiving any exhibits * * * and not for the purpose of agreeing upon actual valuation figures.

No appraisal was prepared by the company.

The State Board of Assessment found a value of the traction property used and useful in Milwaukee, of $8 931 317 and a depreciated or existing value of $6 742 271.[1] The appraisal included 12 per cent overhead additions consisting of 4 per cent for engineering and superintendence, 2 per cent for organization and legal expenses,

[1] City of Milwaukee vs. T. M. E. R. & L. Co., 10 W. R. C. R. 1, 106.

3 per cent for interest during construction and 3 per cent for contingencies. This appraisal was subjected to examination at the hearings of the case and the general testimony on the question of value was given on behalf of the company by Prof. Mortimer E. Cooley and Milton G. Starrett. After the hearings had been concluded the appraisal was subsequently carried up to January 1, 1910, the cost of reproduction new being found as $10 179 167 and the depreciated or existing value as $7 615 992. The valuation as found was substantially that previously determined, since the Commission found from the books of account that the investment in tangible property for the three-year interval was $1 208 630 the net addition to the total valuation amounting to the small sum of $9 220.

The position taken by the city in its brief after the hearing was to the effect that the investment value for rate making purposes, on January 1, 1907, was $7 435 749 beginning with the value of January 1, 1897, of $3 256 510. The valuation as contended for by the Company amounted on January 1, 1907, to fully $15 679 200, being made up of the $8 885 644 determined as the investment by Judge Seaman in the Circuit Court case, with an addition of $6 793 556 investment for the ten-year period, being the amount, $5 432 868, found by the accountants and additions of $1 360 688 for bond discount and interest during construction, but without additions for going value.

The city did not agree with the engineers of the Commission as to the value they had tentatively determined and on certain questions of apportionment of costs between the city and the suburban properties of the company. The value of the tangible property as contended for was $7 699 774. The company claimed that the appraisal was entirely unnecessary because the actual cost of the property had been fully established, and refrained from comment upon the tentative value, pending the receipt of the revised valuation. It contended that the appraised value on January 1, 1907, should have amounted to at least $12 841 485. The city accepted the 12 per cent named by the State Board of Assessment for the overhead additions to physical property, the company claiming 22 per cent upon the testimony of its witnesses.

The city claimed that no allowance should be made for going value, upon the ground that the company's earnings had always been sufficient to amortize deficits incurred in building up the business. The company submitted an investigation by Professor Cooley, based upon the Circuit Court record and the findings of the accountants since 1897, disclosing a going value of $4 710 675 on January 1, 1907, to which it was claimed interest amounting to $2 860 539 should be added.

In the operating expenses, both the accountants of the city and the company excluded reservations for injuries and damages, legal expenses, insurance reserve, promotion of business, etc., from the operating costs as submitted, using instead actual expenditures for

the years in question. The city claimed that the division between urban and other business of the power plant expenses on a car hour basis was in error, contending that the greater loss in transmission and transformation of current supplied to suburban and interurban districts, and the larger weights and greater speed of interurban cars should result in higher proportionate charges for the suburban and interurban service than for the city service. It also criticized the apportionment of the cost of maintenance of way and structures and maintenance of rolling stock upon the car hour basis.

The accountants for the city in their estimates of cost, included 8 per cent of gross earnings for depreciation. The practice of the company had been to set aside 10 per cent of gross earnings for this purpose. The company's accountants estimated the depreciation at 5.05 per cent of the average investment in tangible property upon the basis of assumed lives, and 5.37 per cent upon the method of comparing investment values on January 1, 1897, and January 1, 1907, and accounting for additions and deductions from property during the intervening period. The company's witness, Milton G. Starrett, estimated depreciation at 5.59 per cent and Professor Cooley at 7.67 per cent of the total cost of reproduction.[1]

The brief submitted by the City Attorney is replete with calculations showing the actual extent of depreciation of the company's property. These calculations resulted in the statement that the depreciation rate for track and electric distribution system was 5.659484 per cent, the depreciation on pavement 5.952864 per cent, the rate for cars and car equipment 13.0012 per cent for the period 1893 to 1897 and 3.7761 per cent for the period 1898 to 1906. The various power plants were estimated as depreciating from 6.0366 per cent to 2.8875 per cent and buildings other than the Public Service Building at the rate of 2.815437 per cent of the original investment. The total rate of depreciation of the property as a whole, covered by the analysis of the city from 1894 to 1906 inclusive, showed a depreciation of 5.29 per cent when appreciation in land was not considered and 4.82 per cent when such appreciation was deducted from the depreciation of other property.[2]

For the year 1907, the company contended that the net earnings available for return upon the investment were \$792 230 on an investment of \$14 317 513, without bond discount and going value, resulting in a rate of return of 5.45 per cent. The city claimed that the net earnings available for return on investment were \$1 323 379 and the estimate of property used and useful \$6 560 665, showing a rate of return of 20.17 per cent.

The hearings before the Railroad Commission began on June 8,

[1] For a comparison of the lives assumed, see City of Milwaukee, vs. T. M. E. R. & L. Co., 10 W. R. C. R. 1,226.

[2] Idem, page 230.

1908, and continued to April 2, 1909. Final hearings and oral arguments were held on June 15, 1911, and the decision of the Commission in the case was handed down August 23, 1912.

This covers in brief form the essential features of the situation in Milwaukee from the consolidation of the various competing companies in 1896. The story is much the same as that in many other cities but serves to indicate that questions of cost have been given more consideration in the years prior to commission regulation than has usually been the case. In the following chapters there will be taken up the costs as found by the Railroad Commission of Wisconsin, and the relation of such costs to the rates of fare and the standards of service prescribed by the Commission.

# CHAPTER XXVIII

## THE MILWAUKEE EXPERIMENT (CONTINUED); THE DECISION OF AUGUST 23, 1912 AND ITS RECISION JANUARY 30, 1915

Synopsis of Decision on Reasonableness of Rates of Fare,—— Cost Factors Determining Reasonableness,—— Joint Costs of Urban, Suburban and Interurban Service,—— Basis of Valuation, Depreciation Allowances, and Rate of Return,——Appeal on Contractual Nature of 1900 Franchises,—— Events Preceding the Woehsner Petition,—— Cost Calculations for Succeeding Years, —— Synopsis of Rescinding Decision of January 30, 1915,—— Withdrawal of Appeal by City.

The decision of the Railroad Commission of August 23, 1912, established the rate of fare in Milwaukee as 13 tickets for 50 cents and involved a reduction in revenues estimated in the decision at $171 784.[1] Other decisions made on the same day extended fare limits in the suburban districts known as East Milwaukee, Wauwatosa and West Allis. The basis of reasonableness was the cost of service, including a 7.5 per cent return upon the valuation as found for rate making purposes. The cost of service for the year ended December 31, 1910, and the resulting income account as determined by the Commission[2] were as follows:

TABLE CLVIII — INCOME ACCOUNT T. M. E. R. & L. Co. 1910

| ITEM | Amount |
|---|---|
| Revenues | $3 787 323 15 |
| Total expenses | 2 523 833 80 |
| Maintenance of way and structures | 134 650 25 |
| Maintenance of equipment | 208 433 58 |
| Power | 308 882 98 |
| Conducting transportation | 961 180 68 |
| Expense burden | 132 026 88 |
| Injuries and damages | 132 556 31 |
| Other reserves | 36 876 75 |
| Taxes | 200 328 37 |
| Depreciation | 408 898 00 |
| Surplus available for return on investment | 1 263 489 35 |
| Fair value | 10 300 000 00 |
| Return on investment 7.5 per cent | 772 500 00 |
| Excess above return | 490 989 35 |

The Commission pointed out that the available surplus of $490 989 must be reduced by about $62 443 to care for increases in wages of platform labor, by $131 883 to care for the reduction in suburban fares, by from $150 000 to $200 000 to care for interest on cost and depreciation of paving, and by $22 143 to care for expenditures for additional service which it was expected at that time would involve 250 additional car miles per day. These claims upon surplus amount[3]

[1] City of Milwaukee vs. T. M. E. R. & L. Co., 10 W. R. C. R. 1.

[2] Idem page 244.

[3] Idem page 247.

to from $366 470 to $416 469 and did not permit the reduction of $171 784 in revenues following from the sale of 13 tickets for 50 cents but such a reduction it was held, would have been possible if taken in connection with 1911 costs.

The total operating expenses as disclosed by the Company on its books amounted to $2 739 656 as compared with the Commission's findings of $2 523 833 and this, despite the fact that the Commission had allowed $408 868 as reserve for depreciation as compared with $378 732 as set up by the Company. The difference came about through substantial reductions in the Commission's findings as to the Power Plant expenses, Way and Structures expenses, Rolling Stock expenses, General expenses and Taxes, due principally, it appears, to the basis of apportionment, to the several services, of costs incurred jointly by the urban, suburban and interurban business. General expenses were divided between these services upon the basis of total direct expenses and the reserve for injuries and damages reduced from 4.0 to 3.5 per cent of operating revenues. The actual expenditures rather than the amounts reserved were included for promotion of business and the reserve for contingencies.[1] Taxes paid for the year in question were used instead of taxes accrued. Power costs were apportioned upon the basis of an estimate of the power utilized in Milwaukee service and in suburban and interurban service, this amount of current being determined upon the car miles arbitrarily weighted for various types of cars[2] which were tributary to each power plant. The expenditures for Maintenance of Way and Structures were divided by an apportionment which applied specific units to the separate accounts.[3] Maintenances of Rolling Stock was apportioned upon the car mile rather than the car hour basis as used by the company in its books of account.[4] All of these reapportionments had the effect of increasing the operating expenses of the suburban and interurban service. This followed the determination previously expressed in the decision to treat the urban and the suburban and interurban companies or divisions as separate properties in the determination of cost, the Commission stating.[5]

Whether or not these arrangements as to property ownership, control and operation are prejudicial to the interests of the Milwaukee urban passenger is an open question and one of considerable importance in this case. If the corporate income account and balance sheet of the city company accurately reflect all earnings accruing from city service, all expenses occasioned by city service, and all property used and useful for such city service, our inquiry is confined to the evidence relating to the respondent, The Milwaukee Electric Railway and Light Company, and to that alone. If, however, such arrangements are not equitable our determination of facts must include the business of both city and traction company.

The fair value to be taken as the basis on which to compute return was fixed at $10 300 000 as of January 1, 1910.[6] The basis

[1] 10 W. R. C. R. 168
[2] Idem page 188.
[3] Idem page 204.
[4] Idem page 209.
[5] Idem page 20.
[6] Idem page 159.

for this determination is disclosed in the order of November 25, 1913 in which the valuation was subsequently reviewed, the Commission stating[1] that the reserve was added to the present value of the physical property in order to obtain a fair value for rate making purposes. The fair value shown was made up approximately of the following elements:[2]

| | |
|---|---|
| Cost of reproduction new, less depreciation | $7 378 950 |
| Depreciation reserve | 1 839 154 |
| Stores and supplies | 350 000 |
| Working capital | 150 000 |
| Going value | 500 000 |
| | $10 218 104 |

The fair original cost of the so-called physical property was found to be $9 937 079 on January 1, 1910 being made up of $4 488 408, as the value on January 1, 1897, in lieu of the $8 885 644 determined as the investment by Judge Seaman on that date, together with an addition of $4 240 041 for the period January 1, 1907 to December 31, 1906, instead of $5 432 868 as found by the accountants for the City and the Company, the Commission having apportioned property used jointly by the railway and lighting departments in a manner other than that used by the accountants.[3] Following the findings of the accountants the Commission excluded from its list of additions to property all items such as discounts on securities, expenses of organization, commissions, and stock disbursements, aggregating for the traction utility $1 626 105 in all.[4] There wsa also added $1 208 630 to cover additions to physical property made during the period from January 1, 1907, to December 31, 1909.[5]

The appraised value of the physical property on January 1, 1910 excluding stores and supplies, was fixed at $9 942 125, and the cost of reproduction new and the present value at $7 738 950.[6] These appraisals conformed to the Engineer's reappraisal on January 1, 1910 and contained an allowance of 12 per cent to cover overhead additions. Going value was estimated at from $450 000 to $500 000, this amount being based upon an estimate of the cost of reproducing the going value following some fourteen assumptions as to the rate of construction of the property, growth of earnings and increase in total operating cost.[7]

The necessary depreciation reserve was estimated at 5.35 per cent of the value of the depreciable property, the net allowance on the cost of the entire physical property being placed at 4.4886 per cent.[8] The rate of return was fixed at 7.5 per cent of the value of the property for rate making purposes.[9]

[1] In Re Investigation on Motion of the Commission, of the service of T. M. E. R. & L Co. on its Milwaukee street railway lines — Washington Park Advancement Association' Northwest Neighborhood Civic Club, *vs.* T. M. E. R. & L. Co., 13 W. R. C. R. 178,230.

[2] 10 W. R. C. R. 1, 159.

[3] Idem page 104.

[4] Idem page 97.

[5] Idem page 106.

[6] Idem page 159.

[7] Idem page 152.

[8] Idem page 239.

[9] Idem page 243.

The problem of extension of lines involved in the petition led to elaborate apportionments of costs, values and returns to the entire traction system including the suburban and interurban lines. The Commission's finding disclosed in 1910 a return based upon physical property only on the urban and suburban lines of 11.46 per cent. Upon the suburban lines the return was 1.05 per cent and upon the interurban lines 1.84 per cent of the tangible value of the property.[1] The paying haul was computed upon the Bradlee and Ford formulae and also by a method based on a division of expenses into terminal and movement costs as devised by the Commission. For the group of city lines the Commission found a weighted average half-round trip of 3.615 miles for a single fare. For the year 1910 upon the application of the Bradlee formula the paying haul per car was computed at 4.221 miles per half-round trip. The actual average haul per passenger on city lines was similarly found as 2.93 miles. Upon the basis of the Ford formula as applied by the Commission the possible haul for the year 1910 was found to be 3.1929 miles and upon the Railroad Commission's formula as 3.699 miles.[2]

Appeal from the decision of the Commission was made to the Circuit Court of Dane County and by stipulation the preliminary case was limited to ascertain whether the 1900 franchise constituted a contract which could not be altered and amended without consent of both parties. The trial court held that the provision of the ordinance of 1900 was intended merely as a limitation upon the rate of fare and that it was not the intention of the parties of the contract to fix the rate of fare. Upon the appeal to the Supreme Court of the State of Wisconsin the judgment was affirmed but upon different grounds.[3] Three of the judges held that the statutes under which the franchise was granted did not authorize the making of contracts which would prevent the future exercise of the authority of the State to regulate rates of fares. Two of the judges held that a contract existed, particularly in view of prior decisions of the court involving the 1900 franchise.

Judge Marshall in his dissenting opinion refers to the danger of unsettled fare controversies under continuous regulation and its effect on cost of service to the public.

There was no constitutional prohibition in the way of the city of Milwaukee, by legislative authorization, bargaining with the street railway company as it is claimed to have done. That it possessed such authority in very plain language cannot well be gainsaid. What could be plainer than section 1862: "Any municipal corporation * * * may grant to any such corporation * * * upon such terms as the proper authorities shall determine, (use) of any streets, etc."? * * * Who would be bold enough to contend that the legislative intent was not to afford opportunity to make a contract so that a railway company could safely finance its operations? Such certainly is as important to the public as to the railway company. The uncertainty, in the ex-

---

[1] 10 W. R. C. R. page 283.

[2] Idem, page 291–296.

[3] T. M. E. R. & L. Co. vs. Railroad Commission of Wisconsin, 153 Wis. 592.

perience of any street railway company as to whether it has anything which it can really count on, forms a large element of expense in many ways, which, in the end, has to be charged up to the investment and liquidated in the charge for service. The idea that the public really gains any advantage by holding over an investment in such property the disturbing uncertainty, is a great mistake. The best way to get the best service at the lowest obtainable price is to remove just as far as possible, all dangers to the reasonable income paying quality of the investment.

* * * After resolving all reasonable doubts in favor of the municipality, it yet seems clear to me that the very thing the street railway company and the common council of the city as well, were after was settlement for a long period of the vexed question of fares. The records show, and it is a matter of public knowledge, that disputes as to fares had for years been causing a very disturbed condition of affairs in Milwaukee. It had entered into the political activities of the city as no other question had, and doubtless rendered the future of the corporation so uncertain as to almost paralyze it as regards making advantageous arrangements for rehabilitation and extensions.

The decision of the court was subsequently affirmed by the Supreme Court of the United States,[1] in the following language,—

In view of the weight which this court gives in deciding questions involving the construction of legislative acts to decisions of the highest courts of the States in cases of alleged contracts, and our own inability to say that this statute unequivocally grants to the municipal authorities the power to deprive the legislature of the right to exercise in the future an acknowledged function of great public importance, we reach the conclusion that the judgment of the Supreme Court of Wisconsin in this case should be affirmed.

While the decision of the Commission was pending, suits were started by the City of Milwaukee to compel the Company to repave tracks, where such obligation was clearly stated in franchises granted prior to the passage of the 1900 franchise. The City's contention in these respects was sustained by the Supreme Court of the State of Wisconsin. Subsequently further action was taken to construe the word "repair" in the 1900 franchise in respect to new paving to be constructed in the zone of tracks laid after the year 1900. The court indicated that the police powers of the municipality were probably sufficiently broad to require the Company to pay for the cost of permanent pavement. For the five years ended December 31, 1914, this addition in new paving amounted to $680 160 and the fixed charges on such paving together with maintenance and replacement expenditures for which the company was previously obligated amounted to $266 856 per annum. Obligations imposed by ordinance for street sprinkling, cleaning track and removal of snow and ice, amounted for the five years ended December 31, 1914, to an additional $29 668. The appraisals of the State Board of Assessment were a small part of the values set by the Wisconsin Tax Commission, and as a result the taxes of the traction company increased from $164 828 in 1910 to $280 742 in 1914.

[1] T. M. E. R. & L. Co. vs. Railroad Commission of Wisconsin, 238 U. S. 174.

On November 25, 1913, the Commission ordered fixed standards for service for The Milwaukee Electric Railway and Light Co., which service was estimated to cost from $99 000 to $104 000, as compared with the $22 143 estimated as sufficient in the decision of August 23, 1912. On January 2, 1914, the Railroad Commission fixed the single fare limits and determined zone rates of fare for the suburban and interurban lines.[1] In a decision on the rehearing of this case on October 28, 1914, adjustments were made providing for the sale of 30 zone tickets for 50 cents or 1⅔ cents per zone, and for further extending the city fare zones.

Application was made by the Company for re-hearing in the service case, and on January 14, 1915, appeal was taken to the Circuit Court of Dane County, from the order of October 28, 1914. The petition pointed out that the suburban business had, according to the Commission's own figures as to valuation, and on its basis of apportionment, earned 1.05 per cent in 1910, 1.11 per cent in 1911 and 0.23 per cent in 1912, and that for the last ten complete calendar months had been operated at a deficit of $21 676 (or at the rate of 2.65 per cent) below operating expenses alone, that the actual investment in the property used exceeded that taken as the basis of rates by the Railroad Commission; that determining cost of service in the City of Milwaukee for the year 1914 on the Commission's own basis, the value of $15 441 000 showed a return of 5.56 per cent, and for the 10 months ended with November 30, 1914, a return of 4.03 per cent.

Following this appeal, Christ Woehsner, the Mayor of the City of Cudahy, Wisconsin, one of the suburban points affected, filed an application on December 7, 1914, stating that the Commission's order of August 23, 1912, providing 13 tickets for 50 cents was believed to be unreasonable and unjust and that it operated to prevent the patrons of the suburban system from obtaining low rates and requesting that the earnings of the city business be combined with the suburban business and considered as a whole in order that the city of Cudahy might have relief. The Commission in its opinion on January 30, 1915, rescinded its order of August 23, 1912, which provided 13 tickets for 50 cents.[2]

The Woehsner decision contains a thorough analysis of the changed conditions occurring since the Commission's order of December 31, 1911. It was found that the physical property used for railway purposes in Milwaukee had "increased from approximately $10 000 000 in 1910 to $15 000 000 at the beginning of 1915, or an addition amounting to 50 per cent of the 1910 property". The decision finds that these extensions have included new track, additions to car barns, substations and power plants, additional cars and particularly the city of Milwaukee's "recent requirements that the Company pave the track zone", requiring capital expenditures for the four years of $593 871. It finds further that of the maintenance expenses, $24 249

[1] These cases are further referred to in discussing the regulation of extension of lines and service standards in Chapter XXIX.

[2] Christ Woehsner vs. City of Milwaukee, T. M. E. R. & L. Co., M. L. H. & T. Co. 15 W. R. C. R. 724.

in 1914 has been "due to public requirements". It finds that the $83 400 increased cost of operation has been directly due to wage increases of trainmen and added employes required to comply with the service order. It finds an "unprecedented rise" in the transfer ratio and that the "conservative estimate of the annual loss occasioned by the use of crosstown transfers" amounts "to $80 000 for 1914 alone". It finds that the general trend of industrial and financial conditions has been such as to increase considerably the price of materials, labor and capital, and in many ways to alter substantially economic conditions. During the past 18 years, for instance, prices of commodities appear to have increased generally not far from 50 per cent, while labor in practically all lines commands much higher wages. "Conditions of this nature affect the cost of furnishing utility service as well as the power to utilize the same. Such conditions are also of far-reaching importance and can not be safely disregarded in such cases as the one before us."[1]

The Commission concludes that upon the cost of reproduction of physical property only as of January 1, 1914, or $15 027 019, the surplus available for returns on the city system amounts to 5.45 per cent and on the cost of reproduction of the property of the suburban and interurban lines, or $6 765 329, the amount available for returns was 2.28 per cent, or an average of 4.47 per cent on the entire traction system combined. It finds that should additional amounts be expended as ordered for service and effect be given to changes already ordered in suburban fares, the returns would further be reduced upon the City system in 1914 to 3.48 per cent. Upon the cash investment value and the value as found by the Tax Commission which the Commission states "can hardly be accepted by this Commission in their entirety" but which "contain certain merits which warrant a summary representation in this decision", the Commission finds still lower returns. It concludes:[2]

The increases in the operating expenses and fixed charges of the respondent companies and the failure of their gross and net revenues to maintain their ordinary annual growth during the past few years, that have thus been described, are due to causes that are wholly beyond the control of the respondent companies. These changes, however, as the facts herein clearly show, have resulted in this, that the net earnings of the respondent now are and for some time have been considerably lower on the investment than the rates or costs at which it is well known new capital for similar undertakings can in the long run be had. The conditions in this respect are also considerably aggravated by the fact that in this case, as in nearly all large and growing cities, there is a constantly growing demand for improvements in, and extensions to, the local street railway service. The tendencies and changes in the expenses and earnings in question were seen when the order complained of herein was made, but it was not then thought that they were permanent but rather temporary in their nature. Had the nature of these changes then been better understood, it is very certain that the order in question would not

[1] 15 W. R. C. R. page 744.

[2] Idem, page 749.

have been made. Justice and the law demand that the rates charged by public utilities for the services they render shall be reasonable to the utilities as well as to their patrons. The best interest of the greatest number in matters of this kind can as a rule be best promoted by allowing rates that are high enough to cover the cost of reasonably adequate service. As the rates provided by the order complained of fall short of this, we are, in fairness to the petitioner and in the interest of its patrons, compelled to find that this order is unreasonable and that it should be repealed or abrogated.

Application was subsequently made for a re-hearing on this case by the City Attorney of Milwaukee and arguments heard on June 7, 1915. At the time the hearing was held, formal motion was made by the City Attorney that the petition for re-hearing be dismissed. City Attorney Hoan stated:

As far as the four-cent fare is concerned, I don't say it would be impossible for the city to maintain they could not make a showing; I simply say on the records as they appear before the Commission and the means at hand we have and in view of the new situation which is constantly changing in reference to jitneys, I feel as though the profits of the Company — I may be right or wrong — I wouldn't be able to show that they were entitled to collect that fare. Whether upon investigation or a thorough going over that might be made to show I haven't made any investigation and don't know. I ask therefore that the petition be dismissed without prejudice. I mean by this motion that I do not waive any questions of jurisdiction or any statement of fact that I may have made.

The era of rising prices together with the increased service prescribed by the Commission and the greater contributions made by the Company to the general community burdens, as in the payment of taxes, the construction and maintenance of paving, and the separation of grades, had so affected costs that the Company could not comply with the order of August 23, 1912, and this fact has been recognized by the Commission in its order of January 30, 1915, rescinding the order of August 23, 1912.

This covers in as great detail as space will permit the regulation by the Wisconsin Railroad Commission of the rate of fare charged on the city lines of The Milwaukee Electric Railway and Light Co. In the following chapter the regulation of service above referred to, will be discussed in the light of its relation to the cost of service.

# CHAPTER XXIX

## THE MILWAUKEE EXPERIMENT (CONCLUDED); COST OF SERVICE AND DECISIONS ON LINE EXTENSIONS, ZONE SYSTEM, TRANSFERS AND SERVICE REQUIREMENTS. APPEAL OF NOVEMBER 6, 1915

Commission's Cost Basis of Extending Fare Limits,—— Events Preceding Order of Zone System of Fares,—— Synopsis of Commission's Decision,—— Cost Factors in Orders Extending Transfer Privilege,—— Synopsis of Commission's Orders on Service,—— Cost Factors and Service Standards,—— Crossing Cases,—— Experiments with Skip-Stop,—— Appeal of November 6, 1915.

In addition to the rate of fare certain other regulations intimately affecting the return earned by the Milwaukee companies have been made from time to time. These may be grouped under suitable headings.

### LINE EXTENSIONS

Simultaneously with the decision ordering 13 tickets for 50 cents, the Railroad Commission of Wisconsin on August 23, 1912, rendered three decisions extending the single fare area to West Allis, Wauwatosa and East Milwaukee.[1] The extensions on these lines were not self-sustaining and evidence was before the Commission showing the revenues, expenses and investment involved in the suburban service referred to. In the first case the Commission decided:

> The basis suggested by the company and upon which it has submitted calculations of estimated net earnings assumes that the traffic between first and second fare points shall be considered as a separate unit. It is difficult to see the justice of this assumption. No line is equally well paying upon each portion of the distance it covers and it is manifestly unfair to expect the farthest extremity to be self-sustaining. It seems clear from the relative traffic contributed by the city and the West Allis suburbs that the net earnings obtained by a segregation of revenues and expenses of the first-to-second-fare-zone section are no definite criterion of the value of that traffic to the entire system of which the suburban outlet is a part.
>
> The limit of any extension must be measured by the paying haul per passenger and per car for the entire line and for the system as a whole. Few suburban extensions are paying at the start and the reasonableness of making additions to the present trackage must be determined largely by the profitableness of urban traffic.

With the exception of the three-cent fare case, where the cost of service is based upon the income account for the urban service alone, and the service case of November 25, 1914, in which the Commission states:[2]

> But now the question arises as to the validity of making deductions arising out of single fare extensions from any excess which may

---

[1] Cusick et al vs. T. M. E. R. & L. Co., 10 W. R. C. R. 314, 333; Koenig et al vs. T. M. E. R. & L. Co., 10 W. R. C. R. 337; Village of East Milwaukee vs. T. M. E. R. & L. Co., 10 W. R. C. R. 358.

[2] Washington Park Advancement Association-Northwest Neighborhood Civic Club vs. T. M. E. R. & L. Co. 13, W. R. C. R. 178, 237.

exist in the income account of the city company. These reduced revenues affect the suburban earnings which belong to the Milwaukee Light, Heat and Traction Company's income account, and have only a slight bearing upon the city company's income account.

the suburban and urban business as used has been considered as a unit. The Commission has in its decision of January 30, 1915, stated:[1]

The service within the suburbs adjacent to Milwaukee is in most cases merely an extension of the city service. With few exceptions the same cars operating in the city render the service in the suburbs. There are, no doubt, instances when the suburban system earnings and expenses are given more or less weight according to the nature of the case, but it is certain that seldom, if ever, can such earnings and expenses, when as closely connected with the city system activities as in Milwaukee, be considered as absolute criteria for the adjustment of fares or modification of service rendered. This is the doctrine which seems to have been established in the Three-Cent Fare Case and the subsidiary cases; and was also considered in the Suburban and Interurban Fare cases decided January 2, 1914, (13 W. R. C. R. 475) and in the amendment of this order on October 28, 1914 (15 W. R. C. R. 330).

The decisions in the first three extension cases were based upon the reasonableness of the cost of service standard as applied to the single urban-suburban line. In the West Allis case the extension was ordered on two lines and refused on the third. There followed an accumulation of petitions for adjustments of fare points.

On August 15, 1913, the company filed an application alleging that the tariffs and schedules of the company for its entire suburban and interurban business contained many inequalities with respect to fares and distances,[2] which it was desired to eliminate, and petitioned the Commission to prescribe uniform schedules. The decision of the Commission on January 2, 1914, settled five complaints and led to the establishment of a zone system.[3] The readjustments made resulted in some increases and were the occasion of ten separate complaints to the Commission. These were disposed of by the decision of October 28, 1914,[4] the Commission extending some single fare limits and establishing commutation tickets of 30 mile-zone tickets for 50 cents. The Commission in this decision points out the changed conditions which had occurred since the Three-Cent Fare Case in 1912. It states:[5]

In the Service Case (In re Service T. M. E. R. & L. Co. 1913, 13 W. R. C. R. 178, 239), the income accounts for the Milwaukee metro-

[1] Christ Woehsner vs. City of Milwaukee, T. M. E. R. & L. Co., M. L. H. & T. Co. 15, W. R. C. R. 724, 733.

[2] Chapter XV p. 249.

[3] Robt. Schmieder et al vs. M. L. H. & T. Co. In re petition of T. M. E. R. & L. Co. and M. L. H. & T. Co. with reference to the single fare limits in Wauwatosa; Town of Caledonia vs. T. M. E. R. & L. Co.; O. R. Tower vs. T. M. E. R. & L. Co; Allan D. Stearns vs. T. M. E. R. & L. Co. In re application of T. M. E. R. & L. Co. for the determination of reasonable uniform rates for suburban and interurban service, 13 W. R. C. R. 475. Cost computations presented to the commission and the description of the commission's plan in operation has been described by R. B. Stearns-A Zone System of Fares in Practice—1914 Proceedings, American Electric Railway Association, page 213.

[4] George P. Dravo, E. J. Martel et al, Wm. Bauernfeind et al, City of Wauwatosa, O. R. Tower et al, City of West Allis, Leon Howard et al, John Paulu et al. John P. Beuscher et al, City of South Milwaukee vs. T. M. E. R. & L. Co., M. L. H. & T. Co. 15 W. R. C. R. 330.

[5] Idem, page 336.

politan area for the years 1908 to the close of the fiscal year June 30, 1913, were reviewed. It was here shown how the surpluses above a fair return had been decreasing during this period, due to certain causes enumerated. Explanations of the conditions shown there are unnecessary as they hold as true now as they did then. There is need to add, however, those conditions which have developed subsequent to June 30, 1913. Income accounts prepared for the calendar year 1913 show that after making required allowances the margin above a return of 7.5 per cent has reached small proportions. The return upon the fair value of the property for this far is 8.17 per cent and upon the cost new is 7.18 per cent. An income account prepared for the fiscal year ending June 30, 1914, and for eight months ending September 30, 1914, shows much lower percentages. In addition to the causes, such as rise in prices and wages, increases in paving obligations, investment costs and service requirements, reductions in revenues due to single fare extensions and tickets ordered, 13 for 50 cents, discussed at length in the Service Case, other conditions have developed to change the complexion of the last income accounts. The general depression now on has not only arrested the normal increases of about 5 per cent in city revenues upon which expenses and property budgets have been based, but has brought about an actual decrease in revenues of over $41 000 within the last eight months, thus causing a net decrease in excess of 6 per cent of the annual revenues. As stated in the Service Case, p. 233, the annual expenditure for paving construction was estimated at about $200 000 for 1913 and $125 000 for 1914. The actual paving costs in 1913 were approximately $156 000, while during the fiscal year 1914 these costs exceeded $565 000. The costs for the two years more than double the estimate. A contingency which must also be given some consideration is the decision of the United States Supreme Court regarding 13 tickets for 50 cents. If these reduced fares should become effective, the allowance made on the basis of the Commutation Ticket Coupon Redemption Reserve Fund would only cover about one-half of the reduction and a further reduction between $70 000 and $90 000 would take effect, which would appreciably lower the per cent returns cited previously.

The conditions outlined above in the aggregate have, and will for some time, render the financial aspect extremely unfavorable for any single fare limit extensions. If further increases in expenses occur and such increases are due to public requirement and economic conditions, accompanied by revenue reductions due to business depressions, adequate service must nevertheless still be rendered. The company's revenues, so far as they can be controlled by the Commission, must first insure such service and all other matters should, it is believed, be held in abeyance for the time being. Public policy demands that this course be taken.

### Transfers

The 1900 franchise provides for a single transfer at time of payment of fare. On January 30, 1912,[1] the Commission ordered double transfers upon one of the crosstown lines. On February 3, 1912,[2] the City of Milwaukee made a general demand for double transfers, alleging that such transfers were necessary to eliminate many detours in journeys to places which could not be readily reached by the use of a single transfer. The Commission, in its decision of August 23, 1921, held that

[1] City of Milwaukee vs. T. M. E. R. & L. Co., 8 W. R. C. R. 535.

[2] City of Milwaukee vs. T. M. E. R. & L. Co., 10 W. R. C. R. 352, 357.

under the existing circumstances, "it did not appear necessary to extend the use of the double transfers" but that circumstances might arise in the future when the large amount of crosstown travel through what is at present the outskirts of the city, may have developed to such an extent as to make further use of the double transfers desirable. In this case, the Commission pointed out that the elements of cost involved affected the expense of injuries and damages and cited that from 30 to 50 per cent of the total injuries and damages arose from boarding and alighting from cars and that the use of two transfers would necessitate a double risk. The effect on revenues is also pointed out, the Commission stating:

Another matter must be given careful consideration in the present cost of transfers. The annual reports of the respondent company for the years covering the period 1897-1912, inclusive, show a gradual increase in the use of transfers. The percentage of revenue passengers using transfers during the year 1897 was 25.52 per cent and this has steadily increased to 37.17 per cent in 1911. This increase naturally effects a decrease in the earnings per passenger and as a result the average fare from all passengers including transfers has shown a similar decrease from 3.94 cents to 3.11 cents.

On November 25, 1913, in the Service Case the Commission stated:[1]

On the basis of the investigation made by the staff in this case, it is our opinion that in order to facilitate travel and relieve congestion in the downtown district, it is now necessary that this matter should receive general consideration. The company should make a study of the matter and extend the double transfer system where it is necessary to secure the desired results, and if this is not accomplished in a satisfactory manner, it will be necessary for the Commission to make further investigations and formally consider the question.

The same language is quoted in the decision of July 28, 1914:[2]

The Company has up to this time failed to submit to the Commission a general plan for the extension of its system of double transfers as suggested, and the Commission will therefore proceed to institute an investigation of the matter on its own motion in the near future.

The question of cost of extending the transfer privilege was not considered in these cases. However, in rescinding the single fare order on January 30, 1915,[3] the Commission states:

Another important cause which has prevented the normal increase in revenues established up to 1911, is the extended use of transfers. This is another factor which has operated upon the revenues throughout the entire history since 1897, but whose relative effect has become greater in recent years. The percent of revenue passengers using transfers increased from 25.52 in 1897, to 36.94 in 1913, and within the last year the unprecedented rise took place in this ratio of 2.72 per cent, bringing the total for 1914 up to 39.66 per cent.

---

[1] In re investigation on motion of the commission of the service of T. M. E. R. & L. Co. and its Milwaukee Street Railway lines-Washington Park Advancement Association, Northwest Neighborhood Civic Club vs. T. M. E. R. & L. Co., 13 W. R. C. R. 178, 213.

[2] Twenty-second Ward Advancement Association vs. T. M. E. R. & L. Co., 14 W. R. C. R. 788, 792.

[3] Christ Woehsner vs. City of Milwaukee, T. M. E. R. & L. Co., M. L. H. & T. Co., 15 W. R. C. R. 724, 742.

The revenue passengers decreased from 100 073 659 in 1913 to 97 874 919 in 1914, or a difference of 2 198 740, while the transfer passengers increased from 37 402 570 in 1913 to 39 263 919 in 1914, or a difference of 1 861 349. The most important causes for an increase in the transfer ratio within the last year and since 1911, were the installation of crosstown lines and extended transfer privileges. The following crosstown lines have been established since 1911:

| *Line* | *Opened* |
|---|---|
| 12th St.— 16th Street Viaduct | June 3, 1911 |
| 8th St.— 16th Street Viaduct | Dec. 16, 1911 |
| 27th St.— North Avenue to Fond du Lac Avenue | Dec. 16, 1911 |
| 27th St.— National Avenue to Burleigh | Oct. 21, 1913 |

A conservative estimate of the annual loss occasioned by the use of these privileges has been placed in the neighborhood of $80 000 for 1914 alone.

On July 21, 1915, the City Attorney, under resolution of the Common Council, June 7, 1915, filed a petition with the Railroad Commission, requesting further extension of double transfers on the Center Street line.

## Service Standards

The earliest investigation and order of the Commission as to service was made on July 11, 1907.[1] This decision ordered the maintenance of service equivalent to that obtaining in February and March of that year, required the installation of air brakes, and required daily cleaning of cars. Records of observations during February and March covering the rush periods 6:05 to 8:00 a. m. and 4:36 to 6:38 p. m., showed

> a few individual cars carrying from 100 to 110 passengers, a large number carrying between 90 and 100, and many cars carrying between 50 and 90 passengers. The seating capacity of these cars is 42 in winter and 44 in summer.

This would indicate on the basis of 90 passengers a standard of 48 seats for 100 passengers during rush hours.

On November 28, 1911, and January 30, 1912, orders were issued relating to the routing of cars.[2] In its decision of August 23, 1912, which involved the question of adequacy of service as well as rates of fare, the Commission stated: [3]

> The requirements of good service have been made the subject of separate study by the Commission, and there have just been completed the results of twenty-four hour observations at the points of greatest traffic density. The added requirements of the Commission in this respect will involve about 250 additional car miles per day, and will entail about $22 243 additional expenditure per annum.

On January 24, 1913,[4] the Commission, in an order supplementary to its decision of August 23, 1912, held that some temporary improvements were necessary at that time and recommended that the practice

[1] City of Milwaukee vs. T. M. E. R. & L. Co., 1 W. R. C. R. 662, 669.

[2] City of Milwaukee vs. T. M. E. R. & L. Co., 8 W. R. C. R. 295.

[3] City of Milwaukee vs. T. M. E. R. & L. Co., 10 W. R. C. R. 1, 247.

[4] City of Milwaukee vs. T. M. E. R. & L. Co., 11 W. R. C. R. 338, 342.

of stationing men at important points between 5:00 and 6:30 p. m. to admit passengers through the front doors of PAYE cars and to otherwise assist in loading cars facilitating through movement, be extended to a number of other designated points. The Commission's decision also questioned the adequacy of route and destination signs displayed on the cars, stating that it was its purpose " to issue an order on this subject unless conditions are materially improved within the next few days." Despite the decision in the preceding August the decision states " the Commission recognizes the fact that the cars are very heavily loaded during the evening rush period and that relief is imperative," refers to the necessity of additional franchises, and states that orders covering requirements for additional cars will be issued by the Commission as the details can be worked out for each line. The first decision specifying number of cars, was handed down on February 4, 1913.[1] This order provided that the service furnished on the Eighth Street-Sixteenth Street Viaduct was inadequate, and the Company was ordered to operate additional cars during rush hours.

On November 25, 1913,[2] the Commission handed down a general decision following investigation of car service covering hearings from March 24 to September 24, 1913. The standards prescribed have already been referred to in a previous chapter.[3]

The hearings brought before the Commission the point which had evidently not been given due consideration in previous service orders, namely the financial ability of the companies to comply with the standards prescribed. The briefs submitted by the Company compute the cost of furnishing additional service and point out the additional expenditures required by the Company since the Commission's order of August 23, 1912. These included capital additions of $2 401 453 including erection of car shops, extension of power plants and the building of new car stations. The brief also points out the additional paving obligations imposed since the decisions and orders in the Fare Case and amounting up to that time to an average of $228 000 per annum. It also directs attention to the fact that the Company's maintenance expenditures were $106 450 more than the Commission's 1911 figures and that the injuries and damages required $206 578 more that the Commission contemplated. These operating costs it is pointed out, had increased the cost of street railway service from $3 422 304 to $4 340 457. The brief of the Company also entered into the question of a computation of the cost of peak hour service.

Street railway peak load service is like all other peak load service in being exceptionally costly. Facilities, such as cars, power house equipment, feeder lines, etc., which the company must provide for

[1] City of Milwaukee vs. T. M. E. R. & L. Co., 11 W. R. C. R. 430.

[2] In re investigation, on motion of the commission, of the service of the Milwaukee Electric Railway and Light Company on its Milwaukee Street Railway Lines. Washington Park Advancement Association, Northwest Neighborhood Civic Club vs. The Milwaukee Electric Railway and Light Company, 13 W. R. C. R. 178.

[3] Chapter XII. Prescribed Standards of Service, page 177.

passenger service for only a small fraction of the day, necessarily are more costly for each passenger carried thereon than facilities which can be used all day long.

In considering additional peak hour service we take the present average service of 3.77 hours for 250 days, which equals 942.50 car hours per year per car. Operating costs varying with the car hour run in 1912 amount to 51.7 cents per car hour. This amount represents the average cost for an 18 hour day, and will be increased for an addition during peak hours. Of the total unit cost of 51.7 cents the greater part, 50.1 cents represents the wages of conductors and motormen. An hourly wage of 25 cents for an average of 3.77 hours would aggregate 94.3 cents a day, and extra help obviously would not be secured at this rate. Under present operating conditions a limited number of new men would be obtained for rush hour service in anticipation of contemplated advancement to full day runs; but the Company's present number of 259 tripper cars as compared with 199 regular cars has more than absorbed such service. Student help has been suggested as a solution to this difficulty, but such emergency help would have to earn at least $6 a week, and the cost would probably amount to at least 7 cents an hour more than the 25 cent average figured on. It is reasonable to compute this cost varying with the car hour for extra tripper service as amounting to 65.6 cents per car hour if any considerable addition of cars is made, and this would mean $618.28 per car per year.

Coming to operating cost, varying with the car mile the company's expense for 1912 was 2.54 cents per car mile; assuming an average speed of eight miles an hour, each car would have 7540 car miles annually, and the cost for additional service would amount to $191.52 per car per year.

The operating cost for electric energy of the company during 1912, shows an expense for power of 2.56 cents per car mile operated. An average amount of 3.66 kilowatt hours were consumed per car mile at an average cost of 0.7 cents per kilowatt hour. This amount understates the cost of furnishing electric energy for traction service since it results from apportioning all cost of station operation on a kilowatt basis without reference to the demand. A re-apportionment attempted by the Commission in the single fare cases discloses that approximately 66.66 per cent of the total costs of power were output costs and 33.33 per cent demand costs. Assuming the average cost as correct and the average hours daily use of the demand as 12 hours, peak-hour service would cost as follows:

| *Hours daily use of demand* | *Demand cost* | *Output cost* | *Total cost* |
|---|---|---|---|
| 4 | 0.92c | 0.47c | 1.39c |
| 8 | 0.46c | 0.47c | 0.93c |
| 12 | 0.23c | 0.47c | 0.70c |

Accordingly, an additional service of 3.77 hours use of the demand per day would amount to at least 1.4 cents per kilowatt, or 5.12 cents per car mile. On this basis the cost of additional service of 7,540 car miles (being the car mileage of one car at the peak hour, assuming a speed of eight miles per hour) would aggregate $386.05.

Coming to depreciation and return upon the investment, we know each additional car would cost $6 500, car housing facilities $1 000 per car, and additional power plant capacity $3 200 a car, making a total per car of $10 700. Return at 8 per cent would aggregate $856, and taking the Commission's figures for depreciation at 5.5 per cent on cars, 2.2 per cent on car house, and 4.6 per cent on power plant equipment, the depreciation for each car added would amount to $526.70.

The percentage each car would have to bear of the general expenses made necessary would be $226.01.

Adding these figures we find that the total expense of peak hour service is $2 804.56 per year for each additional car.

In the decision of the Commission in the single fare case, the Commission determined that the service requirements to be added would entail an expenditure of about $22 143 per annum, and the determination of the rate of fare was based on this figure. It will be seen from the foregoing analysis that the Commission's allowance would not quite pay for the expense of eight additional cars for peak hour service.

Coming now to the analysis of what the Company has already done since August 23, 1912, the date of the Commission's decision, we find that the Company already has far exceeded the Commission's requirements as to added service. In addition to providing for the increase in the traffic, the Company's total available cars at the time of the decision in the fare case was 474; during the winter of 1912–1913, 30 additional cars were added. Thirty more cars are now in process of construction and will be completed in the Summer of 1913. The Company's traffic has increased 4 per cent per annum. A proportional increase of the cars per annum would have been 19 cars instead of 30 cars, thus making a difference of 11 cars, which the Company added during the Winter of 1912–1913 in addition to the percentage required to keep up with the increase in its traffic. These 11 cars, even if used for only tripper service, would cost the Company $2 804.50 a car per year making a total of $30 849, and thus already exceeding by that amount the allowance for additional service of $22 143 made by the Commission. (10 W. R. C. R. 247.)

The further increase of 30 cars which will be effected by the Summer of 1913 will make another increase of 6 per cent of the Company's available cars, or a total increase of 12.6 per cent within one year. The probable increase in traffic during this time will be approximately 4 per cent and the increase of cars will thus be 41 cars more than 4 per cent (being the increase in traffic). Assuming these additional cars to be used only for peak hour purposes, and thus to have a cost of $2 804.56 annually, this will make an additional burden on the Company for service of $114 984 above the provision for increase of traffic.

Thus it will be seen that the addition made to the service by the Company already exceeds the requirements of the Commission in its order in the fare case; that peak hour service is comparatively the most expensive service, and that any additional service requirement must seriously burden the Company beyond the expense contemplated in the Commission's order for rates.

The decision of the Commission is a denial that the traction business was at that time unremunerative or that the tendencies pointed to lower returns. It states, however,[1]

If these arguments and testimony are sound and well-founded, then it not only follows that the company would be justified in asking for higher rates, but that under the law it would be the plain duty of this Commission to authorize proper and necessary increases in rates. Under the constitution, as well as under the statutes a public service company is ordinarily entitled to rates that will yield reasonable amounts for operating expenses, including depreciation, and for interest and profit on the fair value of the property employed. Of

[1] In re investition of the service of T. M. E. R. & L. Co. 13 W. R. C. R. 178, 215.

this, in the long run, the utilities cannot be deprived even if the commission was shortsighted enough to attempt it.

The cost of rush hour service was computed at $1 900 [1] per car per annum in lieu of $2 804.50 per car per annum referred to in the company's briefs, and it estimates that 1600 additional car miles per day required for compliance with the revised standard, will cost from $99 000 to $104 000 per annum. Upon the application of the company the case was set for re-hearing. Subsequent testimony has brought out errors and omissions in the computation of operating costs and the resulting figures of net income available for return upon the investment. The calculation of additional car miles has been shown to be considerably in error due to the lack of consideration given to car routing to bring cars to the point of maximum loading. The standard, it has been shown, results in superfluous car movements and waste of service without advantage to the public, but at increased cost of service to the company.

### Track Elevation

Track elevation and depression suits affecting the railroads in the City of Milwaukee, have been brought at various times before the Railroad Commission and the orders in these suits have occasioned large unproductive capital investment by the traction utility. In previous cases,[2] the traction company has been compelled to make all necessary changes in its tracks and appurtenances and to do all necessary grading and paving on those parts of the streets occupied by its tracks; the railroad companies have been required to pay the cost of work lying within their rights of way and the City of Milwaukee required to pay for approaches to the portals of the subways and to assume responsibility for any damage to adjacent property or business. In the decision of January 30, 1915,[3] the Commission departed from its former rule of segregating the work and requiring each party to meet its own costs, and has required that the railroad company pay 70 per cent, the City of Milwaukee 25 per cent, and the traction utility five per cent of the joint cost of depression, including damages. The total cost does not include any losses of revenues or increases in operating expenses, which may be attributed to the disturbances due to construction. It is estimated that the five per cent of the cost assessed to the Company will amount to between $100 000 and $150 000 exclusive of the loss in business and increased operating cost, specifically excluded from the joint account.

### Skip Stops

The Commission has in a series of cases eliminated stops on interurban lines of the Company, operating within cities. On August 28,

---

[1] 13 W. R. C. R. 178, 244.

[2] City of Milwaukee vs. Chicago, Milwaukee and St. Paul Railway Company, Chicago and Northwestern Railway Company, T. M. E. R. & L. Co., 11 W. R. C. R. 344, City of Milwaukee vs. C. M. & St. P. Ry. Co., T. M. E. R. & L. Co.. 11 W. R. C. R. 350, City of Milwaukee vs. C. M. & St. P. Railway Co., 11 W. R. C. R. 353.

[3] City of Milwaukee vs. C. M. & St. P. Ry. Co., T. M. E. R. & L. Co., 15 W. R. C. R. 762

1915,[1] when it sanctioned the elimination of certain stops in these cities, the Commission stated:

The companies urge that the elimination of all unnecessary stops will improve the service by shortening the schedule and minimizing the interruption to through travel. . . . The principle has been recognized by the Commission as applicable to interurban service in City of Racine vs. T. M. E. R. & L. Co., 12 W. R. C. R. 388, City of Kenosha vs. T. M. E. R. & L. Co., 12 W. R. C. R. 508, and City of Waukesha vs. T. M. E. R. & L. Co., 13 W. R. C. R. 89. There appear to be no reasons for withdrawing from the position there taken. From the standpoint of adequate service, the elimination of some stops is not only within the bounds of reason, but it is advantageous for the traveling public.

On August 13, 1915,[2] on an application to eliminate stops in the City of Milwaukee, the Commission ordered the trial of the designated stop plan on two lines and the skip stop or Cleveland plan on one line and proposed to take a referendum vote after three months of operation. The total number of stops in the City of Milwaukee is 1290 and of these 25.4 per cent, would be eliminated by the general application of this designated stop plan if only such stops were eliminated as are found upon survey to contribute a small amount of traffic. The Commission in its order entirely eliminated a number of "freak" stops. In these and other efforts to improve service and decrease cost, there has been no cooperation on the part of city officials, such as is evidenced in Cleveland.

### Petition of November 6, 1915

On November 6, 1915, a petition was filed with the Railroad Commission, asking for relief from the cumulative effect of the various state and municipal regulations.

The petition alleged that all the orders theretofore issued by the Commission were unreasonable and submitted the following table to sustain this representation:

Table CLIX — The Milwaukee Electric Railway & Light Co. (Covering City Lines)

| ITEM | 1912 | 1913 | 1914 | 1915 |
|---|---|---|---|---|
| Tax valuation | $18,191,000 | $18,700,000 | $20,060,000 | $20,740,000 |
| Per cent return | 6.656 | 5.530 | 4.237 | 3.206 |
| Investment valuation | 16,563,559 | 17,508,284 | 19,071,144 | 19,278,353 |
| Per cent return | 7.310 | 5.906 | 4.456 | 3.449 |
| Rate valuation | 12,502,836 | 13,862,874 | 15,265,896 | 15,096,096 |
| Per cent return | 9.684 | 7.460 | 5.567 | 4.405 |

[1] T. M. E. R. & L. Co. vs. City of Cudahy; M. L. H. & T. Co. and T. M. E. R. & L. Co. vs. City of Milwaukee.

[2] T. M. E. R. & L. Co. vs. City of Milwaukee in re: Stopping places of street cars and reasonableness of ordinance section 1228.

Differences between the several bases of valuation are marked. The percentage return has rapidly decreased until it is much less than the interest rate on municipal bonds. Additional capital for increasing street railway facilities cannot readily be obtained in the face of

TABLE CLX — MILWAUKEE LIGHT, HEAT & TRACTION CO.
(Covering Lines Outside City)

| ITEM | 1912 | 1913 | 1914 | 1915 |
|---|---|---|---|---|
| Tax valuation | $5,780,000 | $6,900,000 | $7,084,000 | $7,360,000 |
| Per cent return | 7.505 | 3.324 | 4.289 | 2.996 |
| Investment valuation | 7,781,305 | 7,890,635 | 8,124,627 | 8,315,733 |
| Per cent return | 2.604 | 2.907 | 3.739 | 2.652 |
| Rate valuation | 6,184,929 | 6,195,208 | 6,274,889 | 6,281,838 |
| Per cent return | 3.276 | 3.702 | 4.841 | 3.511 |

these diminishing returns. The experience of the Milwaukee companies affords an example of the difficulty in determining for street railway utilities reasonable rates and service standards on the basis of past performance without making liberal allowance for future capital requirements and increases in expenses. The hazardous and unstable character of the return on street railway capital is disclosed by the financial history shown in these tables. If the tests for reasonableness of fares applied by the Railroad Commission in previous cases involving the fares of the Milwaukee companies are applicable to the conditions obtaining during the year 1915, it appears that the Commission will be justified in granting substantial relief.

With the reasonable settlement of the action now open on the initiative of the companies, there will have been concluded an interesting chapter in the practice of rate regulation where the theory of cost of service was first applied to reduced fares and lengthened hauls, and later used to reverse these operations.

# GENERAL INDEX

S.

3.50 net